DREDGING OF CAÑO MARTÍN PEÑA
PUERTO RICO
FINAL
PROJECT DESIGN REPORT AND
ENVIRONMENTAL IMPACT STATEMENT

SYLLABUS

This Project Design Report describes the study area's problems, formulates several dredging and disposal alternatives, and prepares a detailed design and draft environmental impact statement of the recommended project. The report was prepared under the U. S. Army Corps of Engineers Support for Others Program, at the request of the Puerto Rico Department of Natural and Environmental Resources.

The study area lies in the center of the San Juan Metropolitan Area. This area is located in the north coast of Puerto Rico. Caño Martín Peña is an important component of the San Juan Bay Estuary connecting the San Juan Bay with San José Lagoon. The eastern half of Caño Martín Peña channel has a very low hydraulic capacity due to many years of organic sediments and debris accumulation.

The recommended project consists of dredging about 750,000 cubic yards of mixed material along the existing channel to provide a, 10 feet deep by 150 to 230 feet wide, rectangular channel delimited by a vertical steel sheet pile bulkhead system. The dredging would begin at the San José Lagoon and extend for about 11,600 feet to end west of the Luis Muñoz Rivera Avenue bridge. Most dredged material would be disposed at two of the largest deep holes located in Los Corozos and San José lagoons. A recreation walkway and four fishing piers would be installed on top of the channel walls along portions of the channel. Portions of the permanent right-of-way will be planted with mangroves. The project requires relocation of many existing utilities, acquisition and relocation of 438 structures, acquisition of 42 acres of permanent and 11.5 acres of temporary right-of-way, and replacement of existing bridges at Luis Muñoz Rivera and José C. Barbosa avenues. Replacement of the Juan Ponce de León Avenue Bridge is not recommended at this time. The estimated cost for construction of the recommended project at November 1999 price levels, including replacing two bridges, is $111,200,786.

DREDGING OF CAÑO MARTÍN PEÑA
PUERTO RICO
FINAL
PROJECT DESIGN REPORT AND
ENVIRONMENTAL IMPACT STATEMENT

REPORT ORGANIZATION

VOLUME ONE

VOLUME TWO

Note: A green page has been inserted as the cover page for the Main Report and each Appendix for ease of identification.

DREDGING OF CAÑO MARTÍN PEÑA
PUERTO RICO
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CONVERSION FACTOR TABLE

LENGTH

1 kilometer = 0.6214 mile
1 meter = 3.2808 feet
1 centimeter = 0.3937 inch
1 millimeter = 0.03937 inch

AREA

1 square kilometer = 0.3861 square mile
1 square kilometer = 247.1054 acres
1 hectare = 2.4711 acres
1 square meter = 1.1960 square yards
1 square meter = 10.76 square feet

VOLUME

1 cubic meter = 1.3080 cubic yards
1 cubic meter = 35.3147 cubic feet

VELOCITY

1 meter per second = 3.2808 feet per second

FLOWRATE

1 cubic meter per second = 35.3147 cubic feet per second
1 cubic meter per second = 22.8241 million gallons per day (mgd)
1 liter per second = 0.0353 cubic feet per second

WEIGHT

1 metric ton = 2204.622 lbs.
1 metric ton = 1.1023 short tons

DREDGING OF CAÑO MARTÍN PEÑA
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ABBREVIATIONS AND ACRONYMS

CCMP	Comprehensive Conservation and Management Plan
DGPS	Differential Global Positioning System
DNER	Department of Natural and Environmental Resources
DTM	Digital Terrain Model
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GPS	Global Positioning System
HAER	Historic American Engineering Record
HDPE	High Density Polyethylene
NEP	National Estuary Program
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic Atmospheric Administration
ODMDS	Ocean Dredged Material Disposal Site
PDR	Project Design Report
PREPA	Puerto Rico Electric Power Authority
PRTC	Puerto Rico Telephone Company
PRWC	Puerto Rico Water Company
SHPO	State Historic Preservation Officer
SJBE	San Juan Bay Estuary
SJBEP	San Juan Bay Estuary Program
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WES	Waterways Experiment Station

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DREDGING OF CAÑO MARTÍN PEÑA
PROJECT DESIGN REPORT AND
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I. INTRODUCTION

A. General

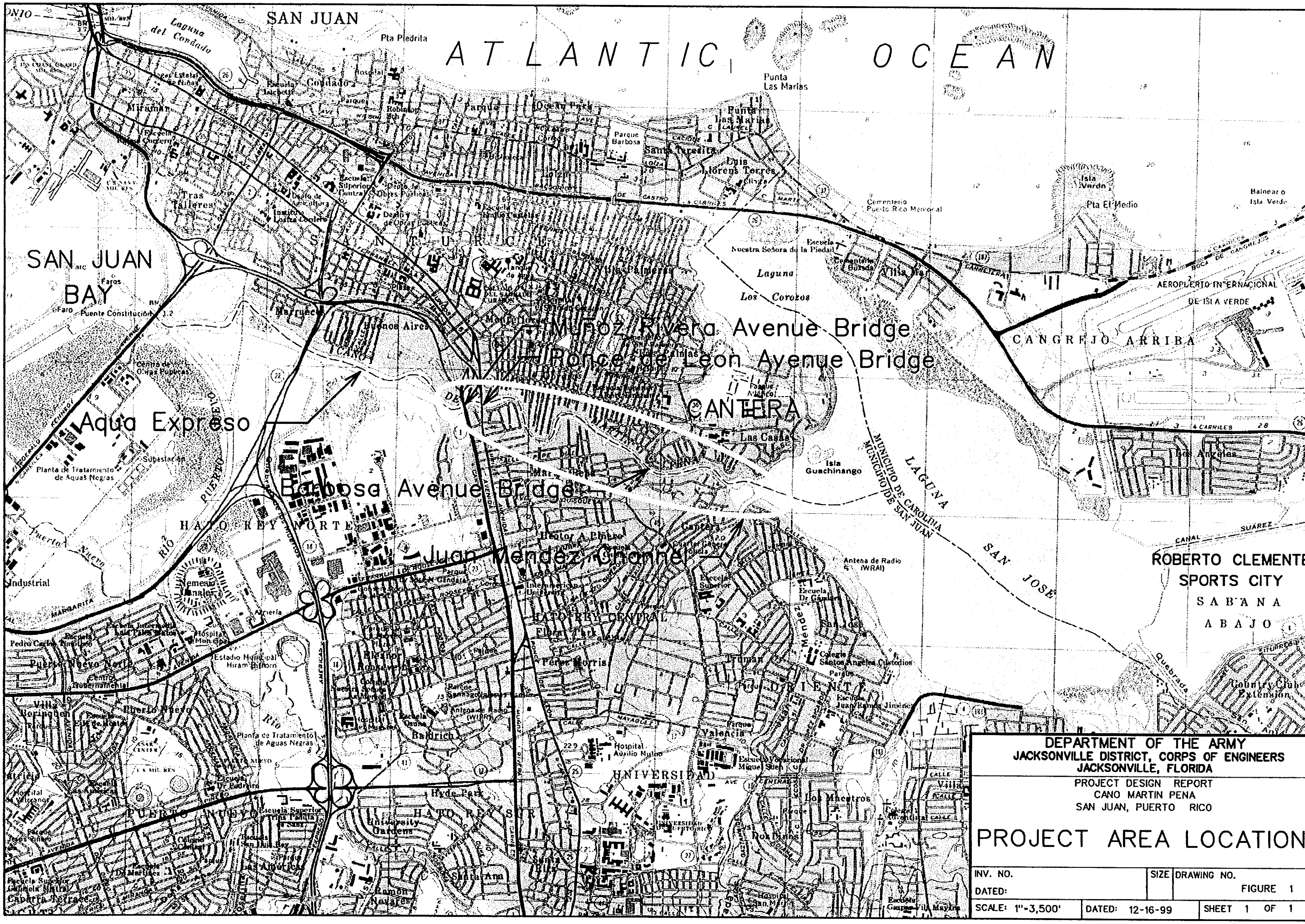
In October 1995, the Puerto Rico Department of Natural and Environmental Resources (DNER) requested technical assistance from the Jacksonville District, U.S. Army Corps of Engineers (USACE) under the Support for Others Program for the planning, engineering, design, and environmental assessment for the dredging of Caño Martín Peña, between Luis Muñoz Rivera Avenue and the San José Lagoon in the Municipality of San Juan (see enclosure 1).

B. Purpose and Scope

The purpose of this Project Design Report (PDR) is to document the plan formulation and design for the dredging of the eastern half of Caño Martín Peña from the vicinity of Luis Muñoz Marín Avenue to the San José Lagoon (See Figure 1). This PDR considers three alternatives that would vary in the size and shape of the channel. The alternatives are evaluated on the basis of their construction method and cost, environmental impacts, real estate requirements, impacts to bridges and utilities, disposal of dredged material, project operation and maintenance, tidal flow capacity, and the recreation and navigation potential. Based on this evaluation and coordination with resources and infrastructure development agencies, DNER selected the recommended project. The detailed design and Environmental Impact Statement (EIS) were developed for the recommended project. This PDR will serve as the foundation for obtaining all necessary permits and for the preparation of Plans and Specifications for project construction.

C. Participants and Coordination

Coordination of this report was accomplished through numerous formal and informal meetings with various Commonwealth and Federal agencies, the Municipality of San Juan, the Municipality of Carolina, the Cantera Peninsula Integral Development Company, local legislators, various interested groups, and residents of the detailed study area. During the process there has been continuous and extensive coordination with DNER and the San Juan Bay Estuary Program (SJBEP).


ATLANTIC OCEAN
SAN JUAN
SAN JUAN BAY
Muñoz Rivera Avenue Bridge
Ponce de Leon Avenue Bridge
CANTERA
Aqua Expreso
Barbosa Avenue Bridge
Juan Mendez Channel
LAGUNA SAN JOSE
MUNICIPIO DE CAROLINA
MUNICIPIO DE SAN JUAN
ROBERTO CLEMENTE SPORTS CITY
SABANA ABAJO
CANGREJO ARRIBA
AEROPUERTO INTERNACIONAL DE ISLA VERDE
Laguna Los Corozos
Isla Guachinango
Laguna del Condado
Punta Las Marías
Pta Piedrita
Pta El Medio
Isla Verde
HATO REY NORTE
HATO REY CENTRAL
HATO REY SUR
UNIVERSIDAD
PUERTO NUEVO
SANTURCE
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
PROJECT DESIGN REPORT
CANO MARTIN PENA
SAN JUAN, PUERTO RICO
PROJECT AREA LOCATION
INV. NO.
DATED:
SIZE
DRAWING NO.
FIGURE 1
SCALE: 1"=3,500'
DATED: 12-16-99
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Meetings held with representatives from the various government agencies and non-governmental entities were aimed at the collection of data necessary for the investigation, assessment and evaluation of impacts from the alternatives considered. A general scoping letter requesting views, comments, or suggestions and information about natural, cultural and community resources, study objectives, and environmental features within the study area was issued on July 23, 1996 to all resources agencies. The letter and comments received are included in the EIS.

D. Prior Studies and Reports

The following is a partial list of relevant previous studies performed by private A/E firms and governmental agencies in the project area. These studies and other valuable information were used in the plan formulation and evaluation for this PDR.

1. Martín Peña Channel, Improvements and Development Study; dated August 1970; prepared by Lebrón, Sanfiorenzo & Fuentes and by Parsons, Brinckerhoff, Quade & Douglas.

2. Water-Quality and Hydraulic Data, San Juan Lagoon System, Puerto Rico; dated 1975; prepared by S.R. Ellis and F. Gómez-Gómez; Puerto Rico Cooperative Water Resources Investigation, U.S. Geological Survey (USGS).

3. Hydrologic Characteristics of Lagoons at San Juan, Puerto Rico, During a January 1974 Tidal Cycle; dated January 1976; prepared by S.R. Ellis and F. Gómez-Gómez; Water Resources Investigation 38-75; USGS.

4. Hydrologic Characteristics of Lagoons at San Juan, Puerto Rico, During an October 1974 Tidal Cycle; dated January 1976; prepared by S.R. Ellis and F. Gómez-Gómez; Water Resources Investigation Open File Report 82-349; USGS.

5. History of Dredging and Filling of Lagoons in the San Juan Area, Puerto Rico; dated September 1976; prepared by S.R. Ellis; Water Resources Investigation 38-76; USGS.

6. Statement of Hon. Elmer Olivieri Cintrón Secretary of Transportation and Public Works, Commonwealth of Puerto Rico, at Hearings Held by the Public Works Subcommittee on Appropriations, on Martín Peña Canal, San Juan Harbor and Ponce Harbor; dated April 12, 1978; Washington D.C.

7. Status Report, Martín Peña Channel; dated May 1978; prepared by Interagency Committee for the development of Martín Peña Canal, Puerto Rico Department of Transportation and Public Works.

8. Special Report on Martín Peña Canal; July 1978, prepared by U.S. Army Engineer District, Jacksonville, Florida.

9. Final Report, Bioassay and Chemical Analyses of Dredged Material, Martín Peña Canal, Puerto Rico; dated April 29, 1983; prepared by Jones Edmunds & Associates, Inc. for Department of the Army, Jacksonville District, Corps of Engineers.

10. Dredging Martín Peña Navigation Channel; dated August 1983, prepared by Department of the Army, Jacksonville District, Corps of Engineers.

11. Inventory of the Flora and Fauna of Martín Peña Channel; dated March 1983; prepared by Oscar Díaz, José Colón, and Bárbara Cintrón for the Puerto Rico Department of Natural Resources, San Juan, Puerto Rico

12. Martín Peña Sector Drainage Works; dated December 1984, prepared by Gustavo E. Fuentes-Sánches for the Municipality of San Juan, Department of Public Works.

13. Ecological Assessment of Highway Construction Impacts: San José Lagoon, Puerto Rico; dated December 21, 1987, prepared by University of Puerto Rico, Center for Energy and Environmental Research for Puerto Rico Highway Authority.

14. Progress Report, Caño Martín Peña and San José Lagoon Intensive Study; dated May 1989; prepared by Environmental Quality Board, Water Quality Planning Bureau.

15. Rehabilitation of Caño Martín Peña and San José Lagoon; dated September 1990; prepared by Alfredo Heres González for Interamerican Association of Sanitary Engineers.

16. Feasibility Study for the Extension of the Water Transportation System of "Agua-Guagua" from Hato Rey to the San José Lagoon; dated May 1990; prepared by Gautier & de Torres for Puerto Rico Planning Board.

17. Permit Application for the Project of the Bridge over San José Lagoon, Carolina-San Juan, Puerto Rico; August 1990; prepared by Lebrón Associates for Puerto Rico Highway Authority.

18. San Juan Bay Estuarine System Nomination Package for the National Estuary Program; dated April 1992, prepared by Environmental Quality Board.

19. Integral Plan for the Development of the Cantera Peninsula; dated August 8 1995, prepared by Puerto Rico Planning Board.

20. San Juan Bay and Estuary Study: Water Quality Data Collection; dated September 1996, prepared by Robert H. Kennedy; U. S. Army Corps of Enginners, Waterways Experiment Station.

21. San Juan Bay and Estuary Study: Hydrodynamic Field data Collection; July 1998, prepared by Timothy L. Fagerburg; U. S. Army Corps of Enginners, Waterways Experiment Station.

22. Synoptic Survey of Water Quality and Bottom Sediments San Juan Bay Estuary System, Puerto Rico, December 1994-July 1995; dated 1998, prepared by Richard M.T. Webb and Fernando Gomez-Gomez; Water Resources Investigation Report 97-4144; U.S. Geological Survey.

23. Draft Hydrodynamic and Water Quality Model Study of San Juan Bay Estuary; dated July 1999, prepared by Barry Bunch, Carl F. Cerco, Mark S. Dortch, Billy H. Johnson, and Keu W. Kim; U. S. Army Corps of Engineers, Waterways Experiment Station.

24. Draft Comprehensive Conservation And Management Plan For The San Juan Bay Estuary; dated September 1999, prepared by Edna Villanueva, Luis Jorge Rivera, Susana Rivera, Mario Tacher, Carmen Guerrero, Catherine Ortíz, Tere Rodríguez; San Juan Bay Estuary Program, Caribbean Environment and Development Institute.

25. Draft Point And Non-point Source Pollutants Loadings Study Of The San Juan Bay Estuarine System, Puerto Rico; dated September 1999, prepared by CSA Architects & Engineers, San Juan, Puerto Rico and Roy F. Weston Inc., West Chester, Pennsylvania.

26. Martín Peña Bridge Study; dated 1999, prepared by S. Corraliza, J.R. Rodríguez, J.R. Gayá, for the Civil Engineering Department, Polytechnic University of Puerto Rico.

E. Projects in the Area

1. Cantera Peninsula Project.

The Cantera Peninsula is a 290 acres low income community located at the eastern boundary of the Municipality of San Juan (see Figure 1). The Cantera Peninsula is bordered on the north by Los Corozos Lagoon, on the east by San José Lagoon, and on the south by Caño Martín Peña. The Cantera Peninsula Project is a private-public partnership that provides tax and investment incentives to the private sector for the redevelopment of the Cantera Peninsula. Law Number 20 of July 10, 1992, created The Company for the Comprehensive Development of the Cantera Peninsula, which is a public corporation that will exist for a period between 15 to 20 years. The portion of Caño Martín Peña that borders the peninsula is the most affected by accumulation of trash and debris, and by houses encroaching on the canal. All alternatives assumed implementation of the features proposed in the approved Cantera Peninsula Master Plan.

2. Aqua Expreso Project.

In 1982, the Puerto Rico Department of Transportation and Public Works requested the USACE to conduct engineering and design studies for developing a waterway along Caño Martín Peña, from San Juan Bay to Hato Rey, associated with the mass transportation Aqua Expreso Project (see Figure 1). A Final Report was completed in August 1983. Funding for this project was provided by the Urban Mass Transit Administration. During the 1960's and 1970's several thousand low income families were relocated from this area by the Municipality of San Juan under the Department of Housing and Urban Development Model Cities Program at a cost of over $125 million.

Aqua Expreso project construction began in 1984 and was completed in 1988 at a cost of $20 million. Work consisted of dredging and ocean disposal of over 1.3 million cubic yards of material excavated from a 10 feet deep by 200 feet wide channel and construction of 13,000 feet of concrete retaining bulkhead. Phase II started in 1987 and was completed in 1988. Docking facilities were designed and built by the Government of Puerto Rico. The completed mass transportation project was inaugurated in March 1991. Even though aquatic mass transportation has not been well supported by the public, this project has contributed to substantial environmental and recreational benefits along the western half of Caño Martín Peña.

3. Quebrada Juan Méndez Project.

Quebrada Juan Méndez is a small drainage system that lies within one of the most densely developed residential and commercial sectors of San Juan (see Figure 1). The outlet of the stream runs south of and parallel to Caño Martín Peña channel for about 1,214 where it discharges in San José Lagoon. Encroachment on the channel by unauthorized residential construction and fill deposition, as well as a lack of channel maintenance, led to the formation of a shoal at the mouth. Prior to construction, the shoal impeded drainage and became colonized by mangroves.

The project for the clearing of Quebrada Juan Méndez was conducted under the authority of Section 208 of the Flood Control Act of 1954, as amended. The municipal government of San Juan was the sponsor for the project. During the three years prior to construction of the project, the Municipality of San Juan invested $2.5 million to relocate 35 families that were living in areas required for construction and maintenance. The project consisted of removing an existing shoal to restore channel cross section. The shoal was a major cause of upstream flooding and health hazards to 290 residential and commercial structures near the channel's outlet. The shoal extended about 1,640 feet upstream from the outlet at San José Lagoon. The bottom of the Lagoon in this area has an average depth of about 3 feet. The channel was re-opened based on a trapezoidal section with a bottom width of 56 feet with side slopes of 1 on 4, and an average top width of 89 feet and with a depth of 3.3 feet. Excavation work was performed by a long arm backhoe working from the southeast channel bank. Channel cleaning activities generated about 15,700 cubic yards of dredged material. The dredged material was hauled by truck to the San Juan Sanitary Landfill.

4. San Juan Bay National Estuary Program

In October 1992, the U.S. Environmental Protection Agency (EPA) declared, at the request of the Government of Puerto Rico, the San Juan Bay Estuary System an estuary of national significance and added it to the National Estuary Program (NEP). The NEP, managed by the EPA, identifies significant estuaries threatened by pollution, development, or overuse and promotes the development of comprehensive conservation and management plans to achieve protection or improvement of water quality and enhancement of living resources.

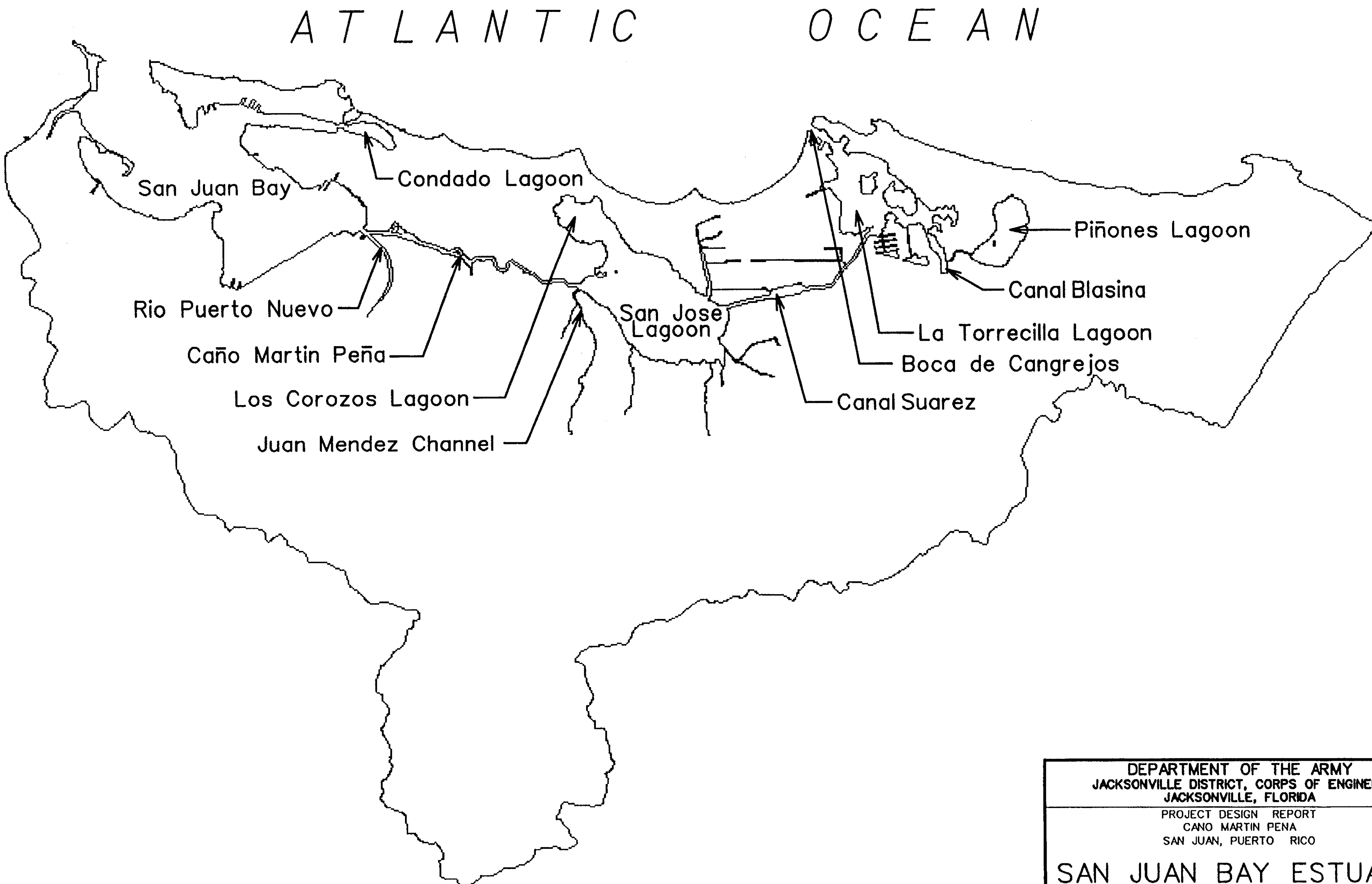
The San Juan Bay Estuary (SJBE) is the first and only tropical estuary of the NEP and therefore may also act as a demonstration project for the rest of the Caribbean. Caño Martín Peña is part of the designated San Juan Bay National Estuary Site that also includes the San Juan Bay, Condado Lagoon, San José Lagoon, Los Corozos Lagoon, Suárez Canal, La Torrecilla Lagoon and the Piñones Lagoon (see Figure 2).

The San Juan Bay Estuary Program (SJBEP) sponsored a comprehensive and detailed study to develop hydrodynamic and water quality models of the estuary for use in determining effective alternatives for water quality improvements and predicting impacts of future infrastructure projects and developments. The development of model included four mayor tasks:(1) bathymetric surveys; (2) hydrodynamic field data collection; (3) water quality data collection; and (4) hydrodynamic and water quality modeling.

A three dimensional hydrodynamic model, previously used for the Chesapeake Bay Study, and a time-varying, three dimensional, numerical water quality model, were developed and implemented for the San Juan Bay Estuary System by the USACE, Waterways Experiment Station (WES). The initial modeling effort included ten sets of simulations to assess the impact of proposed management strategies on water quality. The initial simulation calibrated the model for existing conditions. Five other scenarios involved some form of bathymetric and/or geometric modification which would result in a redistribution of flows. Two scenarios involved only loading reductions. While the last two scenarios evaluated combinations of the most effective geometric modifications and loading reductions.

Of most interest to this report are the four sets of simulations that evaluated the existing conditions base-line scenario, impacts of Caño Martín Peña dredging alternatives, and impacts of filling the deep holes in the lagoons and along Suárez canal. Both models for the San Juan Bay Estuary evaluated concentrations of chlorophyll, salinity, dissolved oxygen, total phosphorous, total nitrogen, and fecal coliforms over a 28 day tidal cycle and at three foot depth intervals.

Under base line conditions scenario, the hydrodynamic model results indicated an attenuated tidal exchange between the ocean outlet at Boca de Cangrejos and San José Lagoon. The model found almost no flow through the eastern end of Caño Martín Peña impeding tidal exchange between the lagoons and San Juan Bay. The water quality model results for Caño Martín Peña indicated anoxic



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JACKSONVILLE, FLORIDA

PROJECT DESIGN REPORT
CANO MARTIN PENA
SAN JUAN, PUERTO RICO

SAN JUAN BAY ESTUARY

INV. NO.	SIZE	DRAWING NO.
DATED:		FIGURE 2
SCALE: NTS	DATED: 11-24-99	SHEET 1 OF 1

bottom water, high concentrations of surface chlorophyll, total nitrogen, total phosphorus, and fecal coliforms.

5. Tren Urbano

The Puerto Rico Department of Transportation and Publics Works is constructing a $1.7 billion light train system (Tren Urbano) most of it on elevated tracks, from San Juan to Bayamón. The guideway section of the Tren Urbano over Caño Martín Peña would span the channel at a site between the bridges on Ponce de León Avenue and Muñoz Rivera Avenue. It spans the channel with 2 support piers inside the waterway. These are approximately 148 feet from each other with pile caps above the water line.

II. PROBLEM IDENTIFICATION

A. General

Over the past fifty years, the Caño Martín Peña has served as the main drainage canal of the traditional urban core of the City of San Juan. The canal is highly polluted with solid wastes and debris. There are a large number of very low-income families living within its banks in very poor substandard housing. However, because of these conditions, the Caño Martín Peña offers a great opportunity for improving the environmental quality of the entire San Juan Bay Estuary System.

Historically, the Government of Puerto Rico included in its goals the preparation of a comprehensive plan for the development of Caño Martín Peña. Since the early 40's there were plans to construct an inland navigation channel along Caño Martín Peña. In the early 50's, plans were developed in order to improve the living conditions of the families that lived in the slums established along its banks. In the 60's and 70's a massive urban renewal project based on permanent relocation was undertaken in the western half of Caño Martín Peña to accommodate the Muñoz Rivera Expressway and the Aqua Expreso projects. In the 80's the Aqua Expreso project was constructed and some housing projects were developed in the area. Since then, several planing studies have been prepared to clean up the eastern portion of the canal and continue with urban renewal. Urban renewal on the eastern half would be based on rehabilitation of infrastructure and housing rather than massive permanent relocation. These days the objective of environmental and recreation enhancement have also been added.

A 1936 aerial photograph of Caño Martín Peña between Muñoz Rivera Avenue and San José Lagoon, shows a natural channel from 200 to 400 feet wide with an extensive herbaceous wetland, no mangroves, and very limited urban development along its banks (see Figure 3). A 1951 aerial photograph of the same area shows the same widths as in 1936 but with dense urban development along the north bank. A 1962 aerial photograph of the same area shows a reduced canal width, no more than 200 feet, with dense urban development all the way to the edge of both banks.

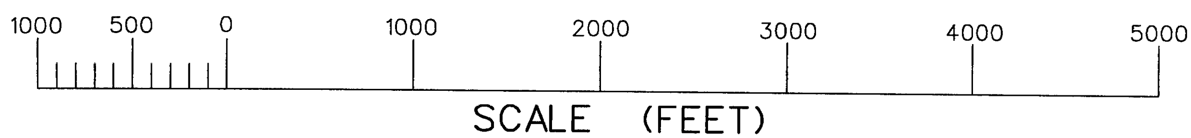
The canal's ability to convey flows has been almost completely blocked as a result of siltation, trash and debris accumulation, and structure encroachments. As a result of the progressive canal clogging, there is very little tidal exchange between the San José Lagoon and the San Juan Bay and the water quality is very poor. This situation is exasperated by the presence in the area of some 3,000 unsewered structures discharging into the canal.

B. Location and Description of Area

The Caño Martín Peña is one of five interconnected bodies of water in the San Juan Metropolitan Area. The canal is approximately 3.8 miles long and extends in an East-West direction through the urban center of the highly populated City of San Juan (see Figure 2). It connects the San Juan Bay with San José Lagoon and Los Corozos Lagoon, which are further connected by the Suárez Canal to La Torrecilla Lagoon and to the Atlantic Ocean. The entire estuarine system of interior coastal Lagoons and tidal canals is connected to the Atlantic Ocean at both ends. The drainage area of the Caño Martín Peña comprises about 2,500 acres. The detailed project area, for this report, extends from the terminus of the Aqua Express at the Hato Rey intermodal passenger terminal near Luis Muñoz Rivera Avenue Bridge eastward to the San José Lagoon.

C. Existing Conditions

Recent hydrographic and topographic surveys of Caño Martín Peña along the project area indicate that the canal width varies from 200 feet to less than 20 feet and its depth vary from 3 to 0 feet. The area immediately adjacent to the canal is very flat and the ground elevation is very low, barely exceeding five feet above NGVD with an average of three feet above NGVD.



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JACKSONVILLE, FLORIDA

PROJECT DESIGN REPORT
CANO MARTIN PENA
SAN JUAN, PUERTO RICO

CAÑO MARTIN PEÑA 1936 AERIAL PHOTO

INV. NO.		SIZE	DRAWING NO.
DATED:			FIGURE 3
SCALE: AS SHOWN	DATED: 11-24-99		SHEET 1 OF 1

There is no tidal induced flow through the canal due to the hydraulic regime of the bay-channel-Lagoon system. The low velocities have allowed deposition of large amounts of organic materials originating from broken sewers, industries, and direct loads from 3,000 unsewered structures along the canal's banks.

The Caño Martín Peña and its surrounding system of bays and Lagoons are important for local fishermen and are also utilized as feeding habitat by pelicans and wading birds. In its present condition, Caño Martín Peña does not allow free flow of cleaner ocean water coming from Boca de Cangrejos outlet, through its eastern end. This has contributed to the degradation of the water quality in that part which is the central portion of the San Juan Bay Estuary. This in turn has limited the productivity of habitats and led to reduced fish and wildlife diversity. Fish diversity in the shallows has decreased according to local fishermen's observations and as suggested by decreased wildlife feeding activities in the area.

D. Future Conditions

It is expected that Caño Martín Peña would continue to deteriorate by canal siltation and trash and debris accumulation within its banks. This would ultimately lead to a complete blockage of the canal. Inhabitants of the area would continue to suffer social stresses associated with deteriorated air and water quality, frequent flooding, and life threatening health hazards.

Caño Martín Peña represents a unique aquatic ecosystem restoration opportunity with the potential of significantly enhancing the environmental quality of the entire San Juan Bay Estuary System. The proposed channel restoration could also add to recreation, transportation, and tourism opportunities for the San Juan Metropolitan Area.

E. Problems, Needs, and Opportunities

1. Water Quality

The water quality of the Caño Martín Peña is far below minimum acceptable standards. Major sources of pollution include unsewered developments discharges, untreated direct sewer and industrial discharges, surface runoff and subsurface seepage over areas littered with household waste, and direct household waste dumping.

The most severe water quality problems in the canal are the low levels of dissolved oxygen and organic pollutants that cannot support fish life. The canal violates all Federal and local water quality standards, creating a major health hazard.

2. Infrastructure

The present infrastructure along Caño Martín Peña consist of three main highways with bridge crossings, paved local access streets, water lines on bridge crossings, very limited storm and sanitary sewers, two trunk sewers with under canal crossings, telephone and power supply network, limited cable TV, and limited recreation facilities.

Several new additions to the existing infrastructure in the area, include the Tren Urbano station and canal crossing, new housing in the Cantera Peninsula, the new Puerto Rico Coliseum, new recreation parks and associated facilities. There are many ongoing studies and other efforts for improving and/or providing new storm and sanitary sewers to areas with deficient or non-existent sewers. Also, there are ongoing studies and other efforts to improve highways, streets, and recreation facilities.

3. Flooding

Historically, low lying areas along Caño Martín Peña have been subjected to frequent flooding from several sources. Sources of flooding include urban runoff from intense storms over Caño Martín Peña, Barrio Obrero, and Hato Rey; flood flows along Juan Méndez channel; and very attenuated storm surge through San Juan Bay and/or Suárez Canal into San José Lagoon.

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) panel number 720000-0051D and 0054D, a large portion of the canal banks are located within a flood prone area with 100-year base flood elevation of 6.56 feet.

4. Land Use

Since the early 60's, the land and most water along both banks of the eastern Caño Martín Peña have been completely urbanized except for a few pockets of vacant lands and wetlands. Most vacant uplands are soon to be developed by the Cantera Peninsula Project. It is expected that dredging and cleaning of Caño Martín Peña would promote intense redevelopment and intensification of nearby urban areas.

5. Cultural Resources.

The proposed Caño Martín Peña dredging would require replacement of a minimum of two highway bridges as described in Appendix C, Bridge Replacement Requirements. The State Historic Preservation Officer (SHPO) may consider some of these bridges as historical landmarks. The dredging will take place in or near a densely populated area, established more than 50 years ago, which could be a source of historical, cultural, or archaeological properties. All identified significant resources that cannot be avoided by the proposed dredging would have to be documented to Historic American Engineering Record (HAER) standards.

6. Hazardous, Toxic, and Radiological Waste

A site characterization study of Caño Martín Peña was completed in August 1997 (See Appendices B and G). Investigations included chemical analysis and geotechnical testing. Sediment and water samples were collected from 10 canal, 5 land, and 5 lagoon locations. Tests revealed similarities in chemical and textural composition of the uppermost sediments of the entire test area. Elevated total lead and mercury concentrations, as well as lesser concentrations of other compounds were detected in the samples

An environmental site assessment of Caño Martín Peña was completed in June 1998 (See Appendix H). The investigation included collection of soil and water samples and chemical analysis. Soil and groundwater samples were taken from 10 test pits within the dredging area. Three soil samples and one water sample were collected from the alternative land disposal site.

7. Aesthetic Resources.

At present, the aesthetics resources of the eastern Caño Martín Peña are poor. The main reason for this is the household wates, abandoned vehicles, construction debris, and other discards scattered all along both banks. However, both canal banks do have a very narrow mangrove and vegetative fringe with serves as roosting and nesting areas for birds. This provides some aesthetic appeal. Once the construction of the channel walls and channel dredging is completed, and vegetation is re-established within portions of the 25 feet right-of-way behind the walls, aesthetics will improve through a broader canal system with bird life and cleaner water in motion through tidal flows.

8. Recreation Opportunities.

Existing recreation opportunities in the Caño Martín Peña area are limited to several basketball courts and a few solitary backboards and three fairly new and small playgrounds. There are no designated parking facilities along the canal. There are no areas where residents may access the canal for fishing or viewing birds except at the 3 bridges which cross the canal. There is good potential to make this an area where there will be recreational activity with the construction of jogging trails, fishing access, and designated parking facilities.

III. SURVEYING AND MAPPING

A. General

The topographic information used during the design and analysis of this project is from survey data obtained between January 1997 and May 1997. The topographic maps produced have a 1-meter contour interval, and elevations refer to the National Geodetic Vertical datum (NGVD) of 1929. The survey and mapping were performed in three phases as follows:

1. Control

The first phase consisted of establishing the controls network using Global Positioning System (GPS). This was achieved in accordance with the Geometric Geodetic Accuracy Standards and Specifications for using GPS Relative Positioning Techniques by Federal Geodetic Control Committee.

2. Cross Sections

The second phase consisted of a total of eight bridge and channel cross sections at three bridge locations.

3. Photogrammetry

The third phase consisted of photogrammetric mapping of the eastern half of Caño Martín Peña. The aerial photography was flown at a scale of 1:12,000, with digital data captured and a final map produced at a scale of 1 inch = 100 feet depicting a one meter contour interval. The control and the canal cross sections are included in the final drawings. The survey data was furnished in MicroStation Graphic Design format.

B. Hydrographic Survey for the San Juan Bay Estuary

Hydrographic data used during the design and analysis of this project was obtained from the hydrographic survey done for the San Juan Bay Estuary Hydrodynamic Modeling done by the Waterways Experiment Station (WES). The survey was performed between May 1996 and June 1996 and included 253 cross sections at 500-foot intervals for San Juan Bay, Condado Lagoon, Caño Martín Peña, San José Lagoon, Los Corozos Lagoon, Suárez canal, La Torrecilla Lagoon, Piñones Lagoon, and Blasina Canal.

Bathymetric data was obtained by means of a single beam digital sounder (Odom Hydrographics). Positioning the vessel was attained by Differential Global Positioning System (DGPS) which received corrected position information from an U.S. Coast Guard Beacon located in Isabela, Puerto Rico. Navigation was performed utilizing Hypack software, who's working environment interfaced global positioning and sounding data.

The project included the establishment of 14 Horizontal and Vertical control monuments throughout the project area. The horizontal datum is NAD 1927 and the vertical datum is NGVD of 1929. All control surveys were Third Order, Class II accuracy. A Digital Terrain Model (DTM) was developed for the surveyed area having a one-foot contour interval.

IV. GEOLOGY AND SOILS

A. General

Channel bottom material is composed mainly of peat, sands, organic clays, and silts varying in thickness between five feet at the eastern end near San José Lagoon to 40 feet near San Juan Bay. These natural soils are overlaid by sludge and debris accumulated during five decades.

B. Investigations Performed

The field exploration and laboratory testing for this site was carried out in two phases. The first phase was performed by Roy F. Weston Inc., during the period between May through September 1997. The second phase was performed between Geo-Cim and ECG, Inc. during the period between April through June 1998 (Refer to Appendices B, G, and H).

The first phase field exploration consisted of the drilling of 16 core borings of which 11 were drilled in the river and 5 were drilled on land, and laboratory testing. The canal borings were drilled to elevations ranging from -17.0 feet to -22.5 feet NGVD. The land borings were drilled to depths of approximately 60 feet.

The second phase field exploration consisted of the drilling of 19 upland core borings, 28 test pits and laboratory testing. All of the core borings of this phase were drilled along the anticipated alignment of the sheet pile wall for both banks of the canal in order to obtain data for the design of the wall. The borings were drilled to depths of approximately 50 to 51 feet. The test pits were excavated within the boundaries of the proposed channel to provide better information on any debris that was present at the site than could be obtained by core borings. The test pits were excavated to depths of 9 to 12 feet.

C. Laboratory Testing

The laboratory testing consisted of geotechnical indexing tests and analytical tests. The geotechnical indexing tests included sieve analyses, Atterburg limits, field moisture test, specific gravity tests and visual soil classification. The analytical tests included measurements of total organic carbon, oil and grease, total suspended solids, polynuclear aromatic hydrocarbons, pesticides and PCBs, total lead, total mercury and sulfides (Refer to Appendices B, G, and H).

D. Materials Encountered

Generally, the canal borings encountered very soft (zero blow count) black organic silty clay and silty clay with some waste debris in at least the upper approximate 8 feet of the borings.

Some land borings generally encountered gravely sand to clayey silt fill in the upper approximate 5 to 13 feet underlain by very soft organic clay to elevations of approximately -9 to -14 feet. These strata were in turn underlain by very stiff to hard silty clays and clayey silts to the termination depths of the borings at depths of 60 feet. Other land borings generally encountered medium dense sandy gravel and silty sand to the approximate depth of 9 feet underlain by dense sand and stiff to hard clayey silt and clay to the termination depths of the borings at approximately 60 feet.

The second phase core borings generally encountered approximately 2 to 8 feet of a sand, clayey sand or clayey gravel underlain by approximately 8 to 10 feet of debris and very soft organic clay and peat, in turn underlain by much stiffer and denser materials which generally included very stiff to hard clays and very dense sands and clayey sands. Limestone was encountered in three borings at depths between 10 and 50 feet.

The test pits encountered a cap of sand, clayey sand or clayey gravel underlain by very soft peat, clay and debris throughout their depths. Generally, the test pits were excavated until the bottom of the debris was located. The debris consisted of construction materials, such as concrete blocks and wood, and household wastes, such as plastic/glass bottles and containers. Other debris that was encountered included rubber tires and household appliances.

E. Excavation Techniques

Excavation techniques that can be used to remove the dense granular soils and the stiff to hard cohesive materials that were encountered in the upland borings, as well as the debris, include clam shell, drag line, and back hoe. The soft clays and silts in the existing canal can be dredged using hydraulic techniques.

F. Channel Design Slopes

Because the topography of the Caño Martín Peña project area is essentially flat with low relief and because any slope created along the proposed canal alignment will be a temporary construction slope, with the exception of the embankments for the three bridge abutments, slope stability analysis was not considered necessary. Temporary construction slopes of 1V:3H are considered safe.

The existing subsurface materials in the canal are similar to those of San Juan Harbor, except for the presence of the debris in Caño Martín Peña. The analysis of a recent dredge project in San Juan Harbor indicated that slopes of 1V:5H would be anticipated as a result of dredging. Therefore, since debris typically acts as reinforcement in a soft soil, a dredge slope of 1V:5H in the canal is considered conservative.

G. Excavated Material Handling and Disposal

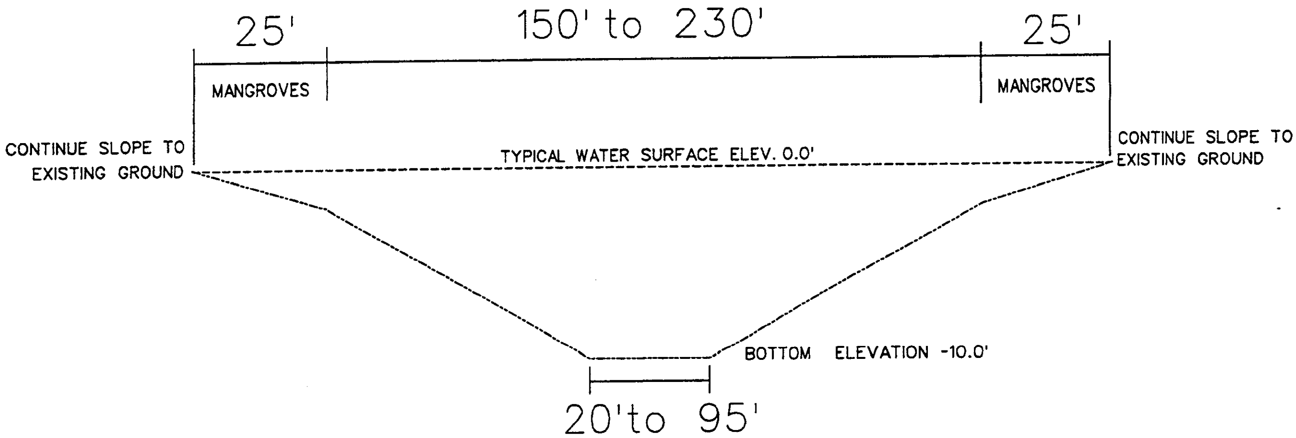
The recommended alternative could generate up to 750,000 cubic yards of excavated material that would require special handling and proper disposal. Recent investigations along the entire canal found mixed materials including solid residential wastes, construction debris, and contaminated organic sediments. Most likely none of the material to be excavated from the canal would be suitable for ocean disposal and an estimated 5 percent would not be suitable to fill deep holes in Los Corozos and San José lagoons. Existing landfills located on nearby municipalities (San Juan, Toa Baja, and Carolina) are expected to be at their full capacity and closed in the near future and cannot accommodate such a large amount of material. There are no nearby suitable upland sites for the development of a new landfill. Details on the disposal alternatives are included in upcoming Section VI.

V. DESCRIPTION AND EVALUATION OF DREDGING ALTERNATIVES

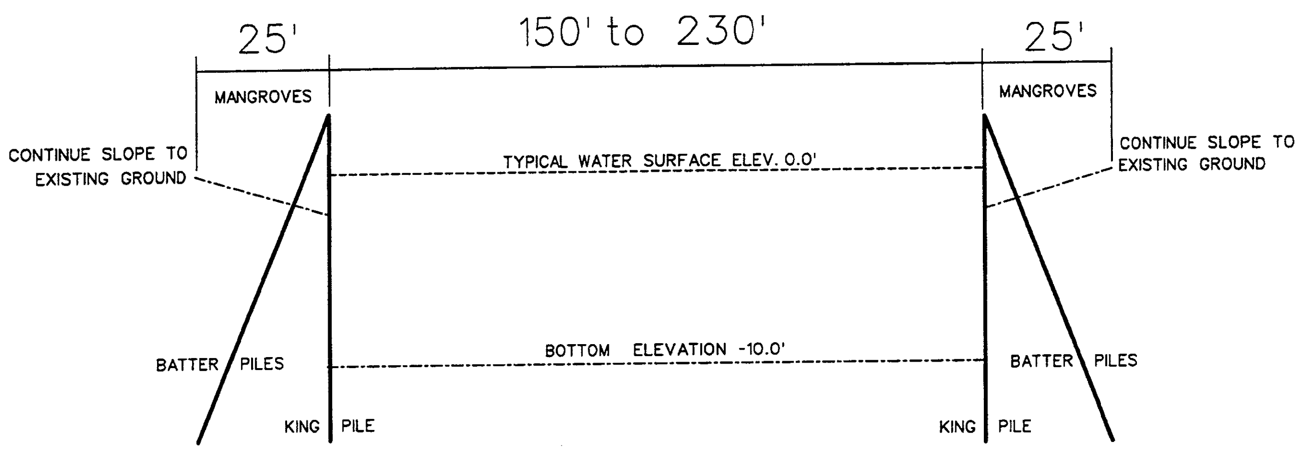
A. General

During the first phase of this report, three dredging alternatives were developed by an interagency team to remove accumulated sediments and debris along the eastern 2.2 miles of the Caño Martín Peña. These dredging alternatives were evaluated in terms of their overall cost, including real estate, bridge replacement, utilities relocations, project construction methods, disposal of dredged materials, operation and maintenance, as well as their tidal flushing capacity and overall environmental value, social and community impacts, and their recreation and navigation potential. The dredging alternatives and a no action alternative are described in the following sections. Typical cross sections of alternatives are shown on Figure 4.

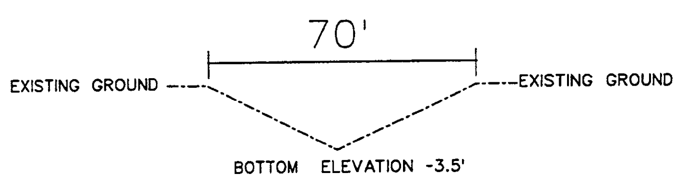
Alternatives 1 and 2 considered a channel width between 150 to 230 feet. The proposed channel width maximizes removal of accumulated debris along existing channel banks, restore the original channel width as discussed in Section II. A., and improve tidal flushing. The proposed channel alignment was selected to minimize relocation of families. Controlled by the existing width and depth of the Aqua Expreso channel, a channel depth of 9 feet plus 1 feet advance maintenance was recommended by an interagency team to maximize tidal flushing. The hydrodynamic model confirmed that a channel 9 feet deep would maximize tidal flushing. Details of the hydrodynamic model are presented in Appendix A.



ALTERNATIVE 1



ALTERNATIVE 2



ALTERNATIVE 3

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

PROJECT DESIGN REPORT
CANO MARTIN PENA
SAN JUAN, PUERTO RICO

TYPICAL CROSS SECTIONS OF ALTERNATIVES

INV. NO.		SIZE	DRAWING NO. FIGURE 4
DATED:			
SCALE: NTS	DATED: 12-14-99	SHEET 1 OF 1	

Alternative 3 considered a channel width of 70 feet. The recommended channel alignment follows the existing channel and minimizes relocation of families. Controlled by the existing Barbosa Avenue Bridge pile caps bottom elevation, a channel depth of 3.5 feet was recommended by an interagency team to avoid impacts to existing bridges and improve tidal flushing. The hydrodynamic and water quality models confirmed that the proposed 70 feet wide by 3.5 feet deep channel slightly improves tidal flushing. Details of the modeling are presented in Appendix A.

Alternatives 1 and 2 would require replacement of existing bridges at Luis Muñoz Rivera Avenue, Ponce De León Avenue, and Barbosa Avenue. Bridge replacement will be required mainly to lower bridge foundation elevation below -10.0 feet, to increase vertical water clearance, and to increase horizontal clearances of bridge spans. These clearances are required to dredge the canal from the water, beginning from San José Lagoon, using a crane with clamshell bucket or long arm backhoe on top of portable barges.

B. Alternative 1

This alternative would consist of dredging a trapezoidal earth channel along the eastern half of Caño Martín Peña. The proposed channel dredging follows the existing Caño Martín Peña channel alignment beginning at San José Lagoon and extends for about 11,600 feet to end west of the Luis Muñoz Rivera Avenue Bridge (See Figure 5).

Channel top width at straight and minor bends sections would be 150 feet. The top width at major bend sections would be 230 feet. The channel depth would 10 feet and the side slopes would be set at 1 on 5. The channel bottom width would vary between 20 to 95 feet. A transition from channel depth of 10 feet to Lagoon depth of 6 feet would be provided where the channel reaches San José Lagoon.

This dredging alternative would require the excavation of about 550,000 cubic yards of mixed materials with a high concentration of household wastes, organic sediments, some sands and clays, construction debris, and fill material.

This dredging alternative would require the relocation of several water, sewer, electrical, telephone, and cable TV utilities in the area. This alternative requires the acquisition and relocation of 438 structures along the channel alignment.


LOS COROZOS LAGOON
CANO MARTIN PENA CHANNEL DREDGING
BARRIO OBRERO
CANTERA PENINSULA
HATO REY
SAN JOSE LAGOON
1000 500 0 1000 2000 3000 4000 5000
SCALE (FEET)
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
PROJECT DESIGN REPORT
CANO MARTIN PENA
SAN JUAN, PUERTO RICO
ALTERNATIVES 1 & 2
RIGHT-OF-WAY
INV. NO.
DATED:
SIZE
DRAWING NO.
FIGURE 5
SCALE: AS SHOWN
DATED: 12-11-00
SHEET 1 OF 1

C. Alternative 2

This alternative consists of a vertical concrete piles with connecting concrete panel walls with earth bottom. This is known as a King Pile Wall, which is similar to the Aqua Expreso project. The proposed channel dredging follows the existing Caño Martín Peña channel alignment beginning at the San José Lagoon and extends for about 11,600 feet to end west of the Luis Muñoz Rivera Avenue Bridge. The proposed footprint is identical to the proposed footprint of Alternative 1 (See Figure 5).

The channel top width at straight and minor bends sections would be 150 feet. The top width at major bend sections would be 230 feet. The proposed channel depth would be set at 10 feet. A transition from channel depth of 10 feet to a depth of 6 feet would be provided where the channel reaches San José Lagoon.

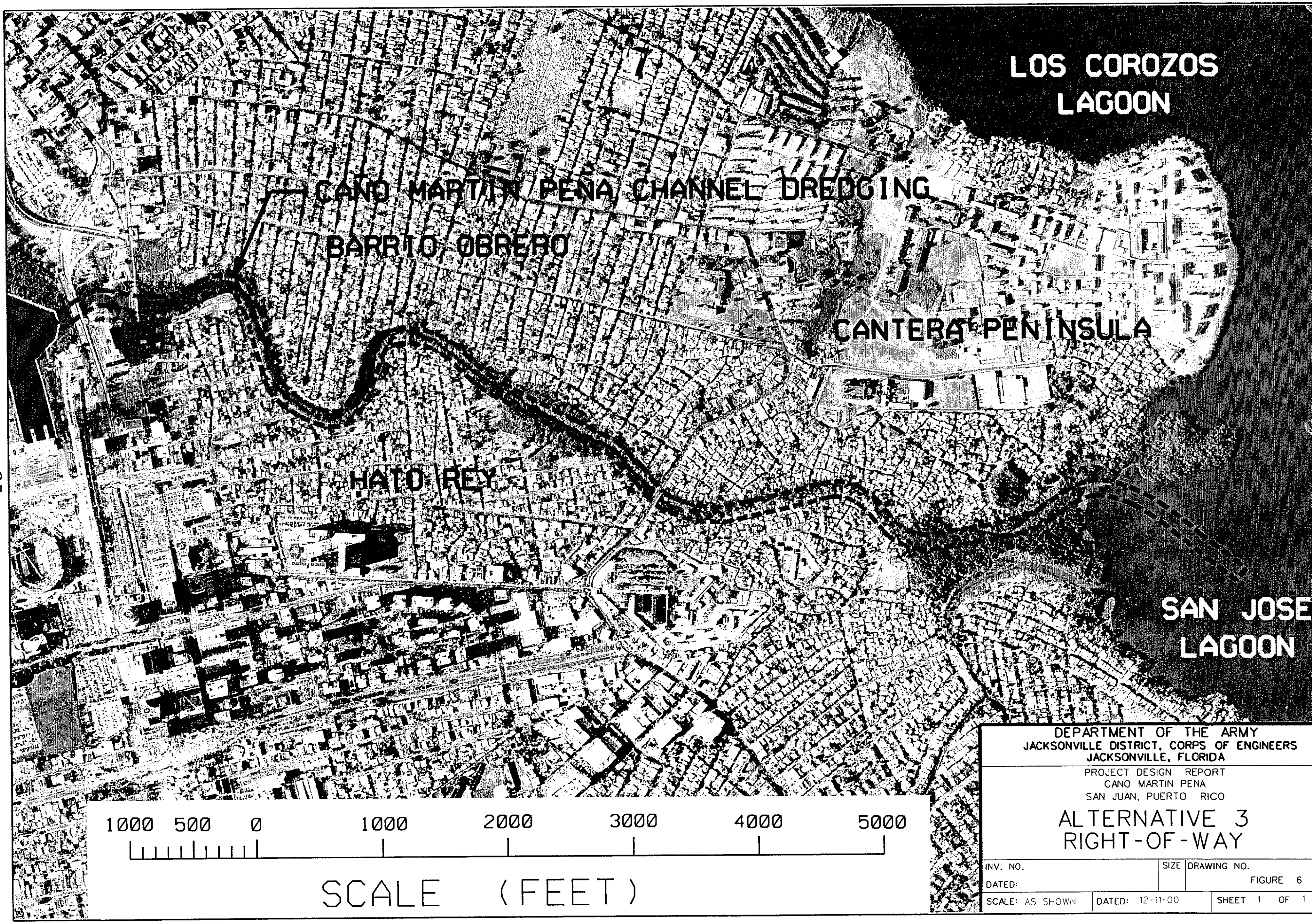
King piles would be precast concrete pile units with a top elevation of 3.0 feet and driven to a tip elevation of -50 feet. King piles would be spaced at 10 feet centers and would have formed slots to install 6 inches thick, precast concrete panel sections. Batter piles would be installed behind each king pile to the same tip elevation to provide lateral support. A continuous, reinforced concrete cap will be placed after piles have been driven and panels installed.

This alternative would require the excavation of about 750,000 cubic yards of mixed materials with a high concentration of solid wastes, organic sediments, some sands and clays, construction debris, and fill material.

This alternative would require the relocation of several water, sewer, electrical, telephone, and cable tv utilities in the area. This alternative requires the acquisition and relocation of 438 structures along the channel alignment.

D. Alternative 3

This alternative would consist of a very limited channel clean up cutting a trapezoidal channel section and constructing a maintenance access road along the eastern half of Caño Martín Peña. The proposed limited channel dredging follows the existing Caño Martín Peña channel alignment beginning at the San José Lagoon and extends for about 11,200 feet to end west of the Luis Muñoz Rivera Avenue Bridge (See Figure 6).


LOS COROZOS LAGOON
CANO MARTIN PEÑA CHANNEL DREDGING
BARRIO OBRERO
CANTERA PENINSULA
HATO REY
SAN JOSE LAGOON
1000 500 0 1000 2000 3000 4000 5000
SCALE (FEET)
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
PROJECT DESIGN REPORT
CANO MARTIN PENA
SAN JUAN, PUERTO RICO
ALTERNATIVE 3
RIGHT-OF-WAY
INV. NO.
DATED:
SIZE
DRAWING NO.
FIGURE 6
SCALE: AS SHOWN
DATED: 12-11-00
SHEET 1 OF 1

The channel top width would be controlled by the existing bridge openings of about 200 feet, and the channel invert elevation would be limited by the Barbosa Avenue Bridge pile caps bottom elevation of about minus 3.5 feet NGVD. Assuming the worst subsurface soils conditions, at this limited depth, the channel side slopes would be set at 1 on 10. Therefore, if the top of bank is located at elevation 0 feet NGVD, the channel top width would be about 70 feet.

This alternative would require the excavation of about 25,000 cubic yards of mixed materials with a high concentration of household wastes, organic sediments, some sands and clays, construction debris, and fill material. It is expected that all excavated material would have to be disposed at a commercial landfill. None of the excavated material would be suitable for ocean disposal or in-bay disposal in the lagoons. The excavation has to be performed by a long boom crane and/or long arm backhoe from a temporary construction road to be laid along both banks. Because of the limited channel template proposed with this alternative, a significant amount of debris would remain within most of the channel side slopes and banks.

This alternative would require the relocation of several water, sewer, electrical, telephone, and cable tv utilities in the area. This alternative requires the acquisition and relocation of 180 structures along the channel alignment.

E. No Action

The no-action alternative supposes continued siltation with severe trash and debris accumulation within both banks of Caño Martín Peña. A "no-action" alternative would ultimately lead to a complete blockage of the channel and continued construction of structures on the filled up waterway. This alternative would not be acceptable to most residents of the study area, the environmental community, or the Government of Puerto Rico.

This alternative would result in the continued physical deterioration of the detailed study area and would seriously undermine its potential for further economic development. Inhabitants of the study area would continue to suffer social stresses associated with frequent flooding, deteriorated air and water quality, and life threatening health hazards. As confirmed by the hydrodynamic and water quality model of the San Juan Bay Estuary System, the "no-action" alternative would lead to further environmental degradation of the entire San Juan Bay Estuary.

F. Recommended Dredging Alternative

An alternative evaluation matrix shown in Table 1, was developed to summarize the relative merits of each alternative in terms of the overall costs including constructability, flushing capacity, real estate, bridge replacement, utilities relocation, and environmental impacts.

For comparison purposes only, and because at the time no other alternative appeared to be feasible or environmentally acceptable, a new landfill disposal alternative was considered in developing the preliminary cost of all channel alternatives. The upland disposal alternative consisted of disposing from 25,000 to 750,000 cubic yards of excavated material from Caño Martín Peña at up to 30 acres of mix wetland/upland vacant land area located in lands owned by the Roberto Clemente Sports City. The disposed material would be contained by a 20 feet high ring levee with a 10 feet top width, a 70 feet bottom width, and 1 on 3 side slopes. The upland disposal site will be prepared and operated with the latest landfill technology including a High Density Polyethylene liner under and over the material, leacheate and stormwater collection/treatment system, gas vents, and a top layer of clay.

Based on a comprehensive comparison of all alternatives, using Table 1, the USACE recommended and DNER selected dredging Alternative 2. A detailed design was developed for this alternative in sufficient detail to proceed to preparation of Plans and Specifications for a construction contract, including project construction cost and project requirements for lands, easements and rights-of-way, utility relocations, bridge replacements, structure acquisitions, and identification of disposal areas for dredged materials for initial implementation and future operation and maintenance.

VI. DESCRIPTION AND EVALUATION OF DISPOSAL ALTERNATIVES

A. General

The recommended alternative for dredging Caño Martín Peña would generate up to 750,000 cubic yards of mixed material that must be disposed at a nearby disposal site. Recent subsurface explorations along the entire canal found mixed materials including solid residential wastes, construction debris, and contaminated organic sediments.

Table 1

Caño Martín Peña, Puerto Rico
Design Memorandum

Dredging Alternatives
Impact Analysis
(Project Costs as of October 1997)

Impacts	ALTERNATIVE 1 150'-230' Trapezoidal 10 Feet Deep	ALTERNATIVE 2 150'-230' King Pile 10 Feet Deep	ALTERNATIVE 3 70 Feet Trapezoidal 3.5 Feet Deep
Project Cost	$ 73.0 M	$ 110.0 M	$27.0 M
Project Maintenance	Significant	Moderate	Substantial
Bridges Affected	Three	Three	None
Utilities Affected	Many	Many	Minimum
Excavated Material	550,000 C.Y.	750,000 C.Y.	25,000 C.Y.
Relocated Housing	438	438	180
Navigation Potential	Limited	Very Good	None
Improvement to Water Quality	Substantial	Substantial	Moderate
Reduced Flooding	Moderate	Moderate	Moderate
Wetland Affected	32 Acres	40 Acres	15 Acres
Wetlands Created	12 Acres	12 Acres	None

Disposal of the dredged material in any place that is considered Waters of the United States, will require a Department of the Army Permit, under Section 10 of the 1899 Rivers and Harbors Act and Section 404 of the 1972 Clean Water Act. The work will also require authorization from the Commonwealth of Puerto Rico's Environmental Quality Board (Water Quality Certificate) and Puerto Rico Planning Board (Coastal Zone Consistency).

During the first phase of this report, four disposal alternatives were developed (See Figure 7). These disposal alternatives were evaluated in terms of their proximity to the project area, special handling, transportation requirements, environmental benefits, environmental impacts, and their overall cost. Details of all disposal alternatives considered and evaluated for this project are described in the following sections.

B. Ocean Disposal

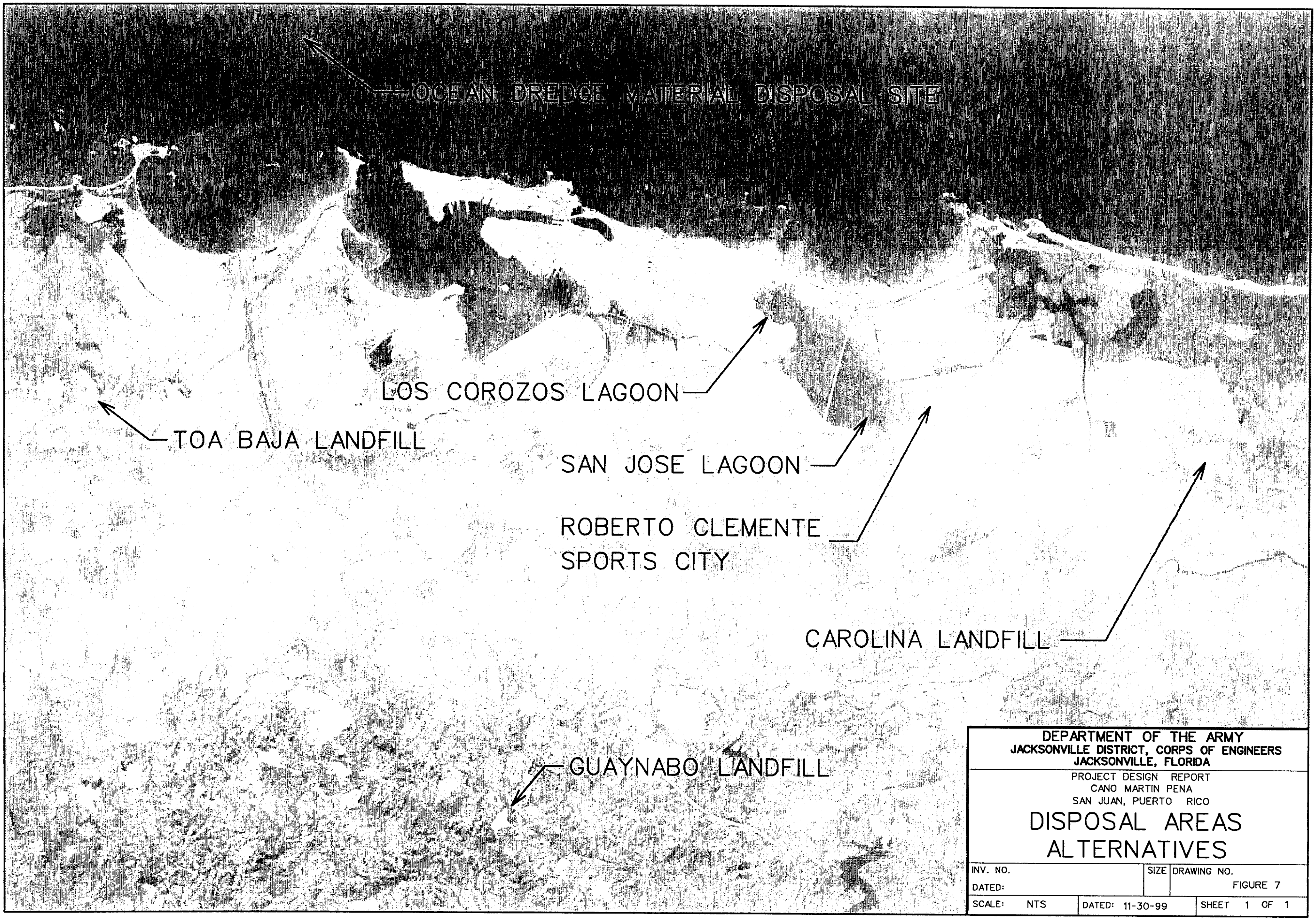
This disposal alternative consist of offshore disposal at the San Juan Ocean Dredged Material Disposal Site (ODMDS). The San Juan ODMDS is an EPA designated ODMDS located approximately 2.3 nautical miles from the San Juan Bay ocean outlet in about 1,200 feet of water (See Figure 7).

Disposal in the open Atlantic Ocean would require all material dredged from Caño Martín Peña to meet the criteria contained in EPA/USACE 1991 Green Book. Most of the material to be excavated from Caño Martín Peña would not be suitable for ocean disposal because levels of lead, mercury, pesticides and other substances were found to be above acceptable levels for ocean disposal of the dredged material. Because of this, costly bioassay testing for EPA 103 concurrence was eliminated from further consideration.

C. Land Disposal

1. Operating Landfill

This disposal alternative consists of disposal at one or more currently operating municipal landfills, within a 10 miles radius of Caño Martín Peña project area, located at the municipalities of Toa Baja, San Juan, Guaynabo, and Carolina (See Figure 7).


OCEAN DREDGE MATERIAL DISPOSAL SITE
LOS COROZOS LAGOON
TOA BAJA LANDFILL
SAN JOSE LAGOON
ROBERTO CLEMENTE SPORTS CITY
CAROLINA LANDFILL
GUAYNABO LANDFILL
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
PROJECT DESIGN REPORT
CANO MARTIN PENA
SAN JUAN, PUERTO RICO
DISPOSAL AREAS ALTERNATIVES
INV. NO.
DATED:
SIZE
DRAWING NO.
FIGURE 7
SCALE: NTS
DATED: 11-30-99
SHEET 1 OF 1

This alternative would require double handling of dredged material. The material would be saturated and would need to be dried out at a very large staging area before it could be loaded into large trucks to be hauled using existing highways to the landfill. It is estimated that handling 750,000 cubic yards of material would require about 50,000 large truckloads.

All currently operating landfills are near their maximum capacity and could not accept any of the 750,000 cubic yards of dredged materials. The land acquisition and relocations process is expected to take from 8 to 10 years. Therefore none of the nearby landfills will be available for use at the projected time of Caño Martín Peña dredging.

It is expected that only regional landfills with the latest technology would be developed no closer than 40 miles from the Caño Martín Peña project area would be available at the time of construction. At best, these landfills could only be utilized to dispose of a small amount of debris within the dredged material that required special handling.

2. New Landfill

This disposal alternative consists of disposal of up to 750,000 cubic yards of dredged materials at a new 30 acres landfill, located within 5 miles of Caño Martín Peña, to be developed within jurisdictional wetlands property of the Roberto Clemente Sports City (See Figure 7).

All the dredged material could be transported in its saturated state in shallow draft barges across Laguna San José. The dredged material would be unloaded at a dock to be constructed at the west shoreline of the Sports City. The dredged material would then be stockpiled near the dock to be later transported to the proposed landfill.

The disposed material would be contained within a 20 feet high ring levee with a 10 feet top width, a 130 feet bottom width, and 1 on 3 side slopes. The upland disposal site will be prepared and operated with the latest landfill technology including a High Density Polyethylene (HDPE) liner under and over the material, leacheate and stormwater collection/treatment system, gas vents, and a top layer of clay. The total cost of developing, operating, and maintaining such a landfill, for 50 years, is currently estimated at over $62.1 millions.

D. In-Bay Disposal

This disposal alternative consists of in-bay disposal to fill two of the largest deep anoxic holes located in Los Corozos and San José lagoons (See Figure 7 and Plate 2). The in-bay disposal alternative has been recommended by the San Juan Bay Estuary Program as part of their Comprehensive Conservation and Management Plan (CCMP), WS-9 Water and Sediment Quality Action Plan (See Appendix A. and Section I.D.24.).

Deep dredging along the shoreline of about 17 percent of the lagoons has increased their volume by about 30 percent. In deep areas, tidal and wind currents are not sufficient to produce enough mixing and the water column stratifies impeding oxygen exchange between the surface and the bottom. Deep anaerobic holes store and produce a nutrient that leads to the formation of dense algae population. The SJBEP models found that if all deep holes in the lagoons are filled, water quality will improve due to an enhancement in circulation and a reduction in the time needed to renew their waters. The storage and production of nutrients in the deep holes will be eliminated. Oxygen-depleted areas and water stratification will be reduced. Improvements in water transparency will increase the possibilities for the establishment of new benthic communities such as seagrass beds. Fisheries and wildlife will be enhanced, especially birds that prey on fish. Waters currently being circulated to La Torrecilla Lagoon through Canal Suárez will have better quality. Tests to samples obtained from both lagoons detected similar conditions to the canal.

All the dredged material would be transported in its saturated state in portable shallow-draft barges to be dumped into two of the largest deep holes located in Los Corozos and/or San José lagoons. Based on hydrographic information, both areas were selected in coordination with the San Juan Bay Estuary Program. Turbidity curtains would be placed around the dumping area to isolate it from the rest of the lagoon and minimize the transport of contaminants suspended as a result of disposal operations.

Based on soil explorations performed along Caño Martín Peña, it is expected that about 5 percent of the dredged material would be debris that would not be accepted for in-bay disposal. The debris would be separated at the work site and later transported by barge to be unloaded at a dock that would be constructed at the west shoreline of the Roberto Clemente Sports City. The debris could then be stockpiled near the dock to be later transported by trucks to a suitable commercial landfill.

E. Recommended Disposal Alternative

After evaluation and consultation with environmental agencies, the recommended disposal alternative consist of in-bay disposal to fill two of the largest deep holes located in Los Corozos and San José lagoons, as described in details in the upcoming Section IX.D., (See Figure 7 and Plate 2). The recommended alternative is considered beneficial use of dredged materials due to the expected water quality improvements.

Disposal Area Number 1 is located in the south side of Los Corozos Lagoon. Disposal Area Number 2 is located in the southeast corner of San José Lagoon. An estimated 5 percent of the dredged material would consist of debris and other material that would not be suitable for in-bay disposal. This material would be temporarily stockpiled in a 5 acres upland area located in the Roberto Clemente Sports City (See Plate 2). The material would then be transported to a commercial landfill.

VII. DESCRIPTION OF RECOMMENDED PROJECT

A. General

The recommended project is similar to Alternative 2, except for the following modifications:

1. The recommended alternative for disposal of dredged material was modified as presented in sections VI.D. and IX.D.

2. After reviewing original Ponce de León Avenue Bridge drawings it was determine that the channel near the bridge could be dredged down to 8 feet deep. Results from the hydrodynamic model shows that this depth is adequate to accomplish tidal flushing because the channel widens here to provide adequate flow area. Therefore, replacement of Ponce De León Bridge is not considered critical for improved tidal flushing and is not proposed as part of the recommended project.

3. The channel alignment near San José Lagoon was made shorter and straighter. As the comparison of Figure 5 and Plate 1 shows.

4. The channel wall design was modified from a King Pile Wall design to a vertical steel bulkhead system. The bulkhead system is easier to construct and repair for about the same cost.

5. Several recreation features were added to the project as discussed in the section below.

B. Recommended Project Features

The recommended project consists of a rectangular channel with a vertical bulkhead system. The proposed channel dredging follows the existing Caño Martín Peña channel alignment beginning at the San José Lagoon and extends for about 11,600 feet to end west of the Luis Muñoz Rivera Avenue bridge (See Plate 1). The estimated cost of channel construction is $49,978,827.

The channel top width at straight and minor bends sections would be 150 feet. The top width at major bend sections would be 230 feet. The proposed channel depth is 10 feet. A transition from channel depth of 10 feet to a depth of 6 feet would be provided where the channel reaches San José Lagoon.

This alternative would require the excavation of about 750,000 cubic yards of material with a high concentration of solid wastes, organic sediments, some sands and clays, construction debris, and fill material. The recommended disposal plan consist of in-bay disposal to fill two of the largest deep holes located in Los Corozos and San José lagoons, as described in Section VI.D. and Section IX.D., (See Figure 7 and Plate 2).

The vertical channel walls will be constructed using corrosion resistant steel sheet piles with a two feet wide reinforced concrete pile cap. On the north side, a five and one half feet wide concrete walkway would be installed on top of the concrete pile cap to serve as an elevated recreation walkway.

The new bulkhead system will also be gapped every 30 feet to allow water circulation into the 25 feet wide permanent right-of-way where the mangroves would be planted, except on the north side along the Cantera Peninsula Project between stations 62+00 and 87+00. Each gap will be 6 feet wide and 2.83 feet high with a bottom elevation of elevation 0.0 and a top elevation of elevation 2.83 feet. The 25 feet permanent right-of-way behind the bulkhead will be degraded to elevation 0.0 for 10 to 25 feet horizontally and then transition to existing grade using a 1 on 3 slope. If the ground behind the bulkhead is greater than elevation 3.0 feet, then it will be degraded to elevation 3.0 feet. If the existing ground surface is relatively flat and less than or equal to elevation 3.0 feet, it will be dressed.

This alternative requires replacement of existing bridges at Luis Muñoz Rivera and Barbosa avenues. Replacement is necessary mainly to lower bridge foundation elevation below -10.0 feet, to increase vertical water clearance, and to increase horizontal clearances of bridge spans. These clearances are required to dredge the canal from the water. The estimated cost of replacing these two bridges is $9,600,000.

As part of the wetland mitigation plan described in the EIS, mangroves will be planted along the recommended project. Mangroves would be planted behind the bulkhead wall only at areas dressed below elevation 1.2 feet NGVD. No mangroves would be planted along the Cantera Peninsula Project, between stations 62+00 and 87+00, where the ground elevation would be made higher and the bulkhead will not be gapped.

The proposed recreation features consist of a concrete platform 5.5 feet wide with two guardrails, on the north side of the canal, which will become the path for use by joggers, pedestrians, and cyclists. On the south side of the channel there will be 4 fishing platforms, similar in width to the platform on the north side of the channel. The platforms will be connected to the bank via elevated ramps. Parking will be provided at all fishing platform locations. The estimated construction cost of the recommended recreation features is $1,875,375. See Plate F-1 in the Recreation Appendix.

The recommended project would require the relocation of water, sewer, electrical, telephone, and cable TV utilities in the area currently estimated at $7,511,210. See Plates E-1, E-2, and W-1.

The recommended project lands consist of approximately 42 acres of permanent channel improvement easement that extends 25 feet on either side of the channel walls. The estimated value of this land is $2,058,000. There are three staging areas that total approximately 11.5 acres of temporary easement with an estimated value of $245,000. The recommended project would require the acquisition of 438 residential/commercial structures along the channel alignment. These structures have an estimated average cost of $21,900,000. The total estimated real estate cost for the recommended project, including acquisition/administrative costs and contingencies, is estimated at $34,520,000. The total cost of the recommended project is $111,200,786.

VIII. HYDROLOGY AND HYDRAULICS

A. General

Predicted impacts of the proposed project to the storm surge flooding were analyzed by the USACE Jacksonville District using a two dimensional tide propagation computer model.

Predicted impacts to water quality due to astrological tidal flushing of Caño Martín Peña under the existing and recommended project conditions is discussed under Appendix A, SUMMARY OF WES SAN JUAN BAY ESTUARY MODEL.

The recommended channel dredging alternative does not include improvements to the existing storm drainage system. The Municipality of San Juan is developing a design to improve the drainage system of the area. Improvements to the storm drainage system would convey storm runoff towards the improved channel. It is predicted that once urban runoff reaches the improved channel it would easily flow towards the San José lagoon and/or towards the San Juan Bay.

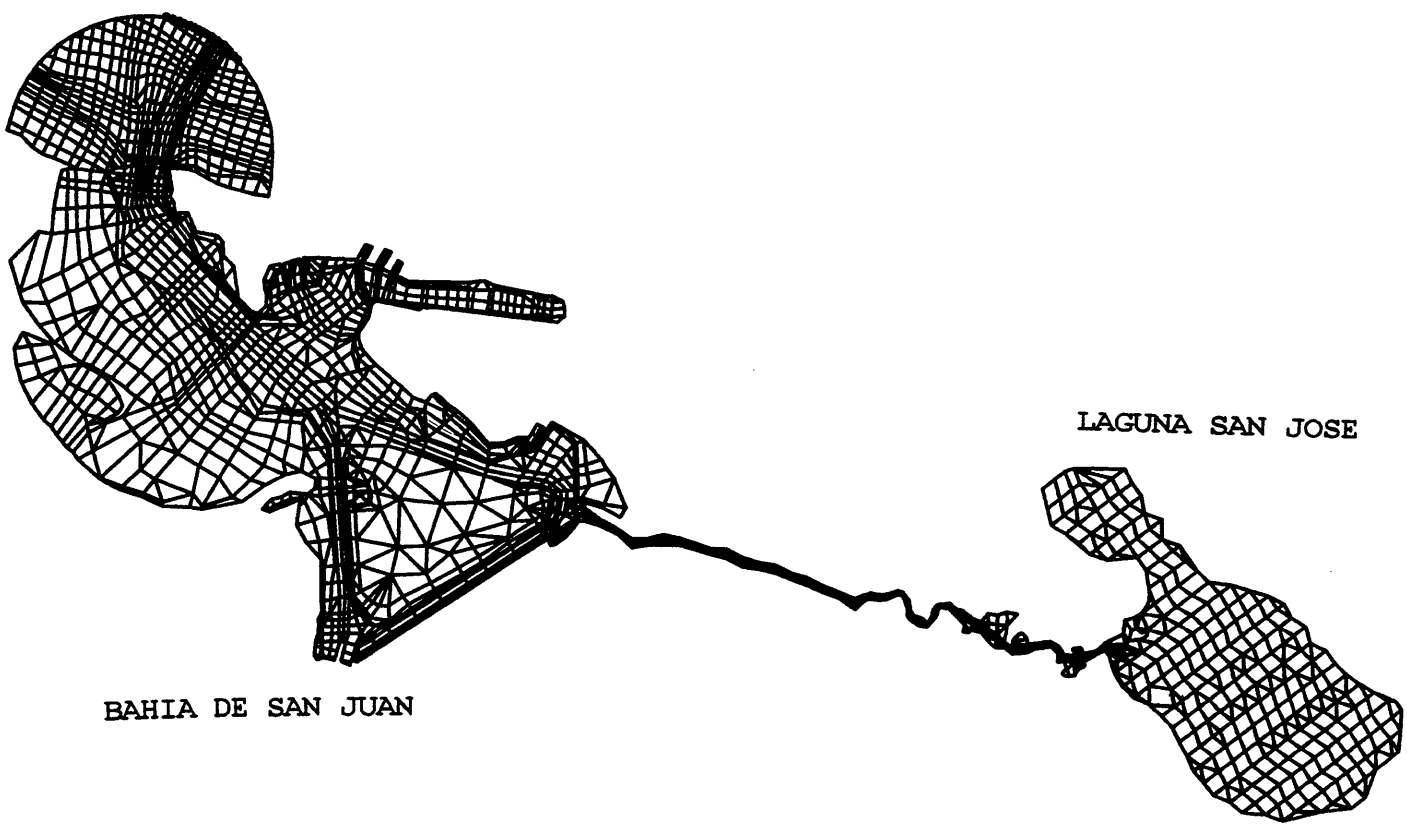
B. Storm Surge Analysis

For existing conditions, the FEMA Flood Insurance Study estimated storm surge elevation of 6.36 feet along Caño Martín Peña between San Juan Bay and San José Lagoon was utilized. A storm surge analysis of the recommended alternative was made to define the storm surge hydraulics of the with project conditions for Caño Martín Peña between San Juan bay and San José Lagoon.

1. San Juan Harbor Model

A two-dimensional grid of San Juan Harbor model, which was previously used to estimate tidal currents for the San Juan Harbor Navigation Study, was obtained from the Waterways Experiment Station (WES). Grid points inside the Caño Martín Peña and San José Lagoon were generated using the bathymetric survey done for the San Juan Bay Estuary Model. Points for overbanks areas of the channel were taken from the topographic survey done for this PDR. The revised two dimensional grid of the San Juan Harbor model is shown in Figure 8.

FIGURE 8



A 100-year tide of 5.3 feet at the San Juan Harbor entrance was taken from the National Oceanic and Atmospheric Administration (NOAA) "Storm Tide Frequency Analysis for the Coast of Puerto Rico" publication and was used as a head boundary condition along the northernmost ocean boundary of the model. No rainfall and no storm runoff were applied to the water surface areas of the model.

2. Existing Condition

For existing conditions, the storm surge elevation of 6.36 feet (2 meters) shown between San Juan Bay and San José Lagoon on the FEMA Flood Insurance Rate Maps 0051D, 0052D, 0053D, and 0054D dated June 2, 1999 was assumed as the without project condition storm surge.

3. With Project Condition

The two-dimensional model was constructed to incorporate the recommended project with a channel width between 150 and 230 feet and bottom elevation of minus 10.0 feet NGVD. Water surface elevations, velocities, and discharges were simulated for the project condition at 15-minute intervals. The computed maximum 100-year water levels in the channel for the recommended project condition are provided in Figure 9.

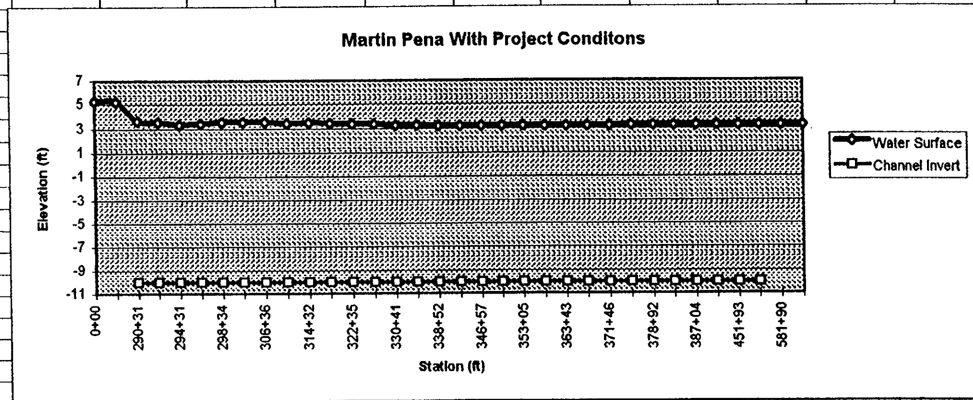
4. Results

The recommended project propagates tidal conditions into San José Lagoon and reduces the estimated FEMA 100-year storm tide level from 6.56 feet to about 3.3 feet. Therefore, the recommended project would reduce tidal flooding of adjacent low areas over the existing conditions by about 3 feet. The proposed improvements will restore tidal conditions to their state prior to encroachments by urban developments.

As compared to the FEMA storm tide elevations for existing conditions, the water surface elevations for the with project conditions shown in the table and profile in Figure 9, results in a 1.6 feet storm tide reduction at the channel entrance. From that point to the San José Lagoon, the remaining storm tide level propagates with very little reduction. Therefore, the with project 100-year storm tide level, at the east end of Caño Martín Peña, decreases from 6.56 feet to 3.26 feet.

FIGURE 10

POINT	XCOORD	YCOORD	RMA-2 EL	STATION	ELEV	Invert	Discription
53	607911	237011	205.3	0+00	5.3		Ocean
5002	620391	221468	205.23	199+34	5.23		
5479	629030	218617	203.65	290+31	3.65	-10	Channel Entrance
	629134	218697		291+63	3.53	-10	Highway 1
5493	629380	218804	203.3	294+31	3.3	-10	
	629584	218776		296+37	3.42	-10	Highway 25
5507	629780	218800	203.54	298+34	3.54	-10	
5521	630164	218909	203.51	302+33	3.51	-10	
5535	630514	218709	203.54	306+36	3.54	-10	
5549	630669	218337	203.43	310+38	3.43	-10	
5563	630883	218007	203.45	314+32	3.45	-10	
5577	631283	217976	203.42	318+33	3.42	-10	
5591	631574	218253	203.36	322+35	3.36	-10	
5605	631933	218419	203.36	326+30	3.36	-10	
5619	632286	218210	203.25	330+41	3.25	-10	
5633	632617	217972	203.23	334+48	3.23	-10	
5647	632960	217760	203.21	338+52	3.21	-10	
5661	633324	217583	203.19	342+57	3.19	-10	
5675	633617	217311	203.18	346+57	3.18	-10	
5689	633930	217057	203.19	350+60	3.19	-10	
	633726	217194		353+05	3.19	-10	Highway 27
5703	634328	217009	203.2	359+35	3.2	-10	
5717	634726	217102	203.21	363+43	3.21	-10	
5731	635117	217192	203.21	367+45	3.21	-10	
5745	635485	217033	203.22	371+46	3.22	-10	
5759	635847	216857	203.23	375+48	3.23	-10	
5773	636190	216865	203.24	378+92	3.24	-10	
5787	636554	216911	203.24	382+58	3.24	-10	
5801	636950	217115	203.25	387+04	3.25	-10	
5815	637462	217122	203.25	392+16	3.25	-10	
6478	635977	222912	203.26	451+93	3.26	-10	
	636955	217193		509+95	3.26	-10	End of channel
6616	646400	215149	203.26	581+90	3.26		
6612	642563	211582	203.26	634+29	3.26		



ELEVATIONS ARE IN FEET, NGVD

BRIDGES AT PR HIGHWAYS 1, 25 AND 27 WERE REPLACED.

IX. DESIGN CONSIDERATIONS

A. General

This section provides all the design considerations for the recommended project as described in Section VII.

B. Construction Sequence

Because of limited access along the canal and weak surface soils conditions, channel dredging and construction of channel bulkhead wall will take place from a barge. The first order of work will be channel excavation and dredged material disposal. Excavation will begin at San José Lagoon and continue towards the west. After channel dredging has begun, installation of the bulkhead wall should commence. The final order of work will be the placing of fill behind the wall and mangrove planting.

C. Channel Excavation

1. General

The proposed channel would be excavated by clamshell/barge, and the suitable dredged material would be placed into barges and hauled to the recommended in-bay disposal areas. The recommended disposal areas are two of several deep holes that were created in the lagoon as a result of a previous sand mining operation. The excavated material would be placed in the holes to a maximum elevation of -10 feet and then capped with 3 feet of suitable clean cover material. All debris would be hauled and temporarily stockpiled at the designated stockpile area and later transported to a commercial landfill.

2. Construction Method

For cost estimating purposes, the method of excavation would by clamshell located on a barge. It is anticipated that two (10 feet by 40 feet) portable barges would be fastened together to form a work platform for the clamshell. The excavated material would be dumped through a rigid screen into a haul barge to be transported to the disposal areas. The screen would separate the debris from the acceptable materials. The debris would be placed on another barge and transported to the dock facility located on the eastern bank of the San José lagoon. The debris would then be off-loaded, stockpiled, and hauled to a landfill.

D. Disposal of Dredged Materials

1. In-Bay Disposal

Two principal in-bay disposal areas have been selected after alternative analysis discussed in Section VI.. Disposal Area Number 1 in the south bank of Los Corozos Lagoon, and Disposal Area Number 2 in the southeast bank of San José Lagoon. A third area, located just north of Disposal Area Number 2 in San José Lagoon, would be available if required. Refer to Plate 2.

A turbidity curtain would be placed along the lagoons -5 foot contour completely around the disposal area during filling operations. A portion of the turbidity curtain would be movable to allow barge movement in and out of the disposal area. The turbidity curtain may not be required during placement of the capping material.

Disposal Area Number 1 would be filled with an estimated 80,000 cubic yards of material from the deepest depth at elevation -23 feet to about elevation -10 feet. Approximately 50,000 cubic yards of capping material would be required.

Disposal Area Number 2 would be filled with an estimated 630,000 cubic yards of material from the deepest depth at elevation -32 feet to about elevation -10 feet. Approximately 205,000 cubic yards of capping material would be required.

During the Plans and Specifications phase, additional studies should be completed to analyze and design in more detail the disposal and capping operation.

The alternate disposal area located just north of Disposal Area Number 2 would be used if additional disposal areas were needed. The alternate disposal area is similar to Disposal Area Number 2 with the deepest depth at about elevation -30 feet.

2. Off-site Disposal

An estimated 5 percent of the material excavated from the recommended project would consist of debris and other floating materials that would not be suitable for in-bay disposal. This material would be temporarily stockpiled in a 5 acres upland vacant area, Staging Area 3, located within the Roberto Clemente Sports City in the Municipality of Carolina (See Plate 2). The accumulated debris would then be transported to a landfill.

3. Dock Facility

A temporary dock facility would be constructed on the east bank of San José Lagoon, at Roberto Clemente Sports City, to load dredged material that must be transported to a landfill and unload construction materials for transport to the construction site. The exact location and size of the facility would depend on environmental impacts and the requirements of the Contractor. The recommended location is shown of Plate 2.

E. Channel Wall Design Alternatives

In 1986, improvements were made to the western half of the canal known as the Aqua Expreso project (refer to Section I.D.10). Improvements included a widening and deepening of the canal and construction of a bulkhead. The bulkhead was a king pile system consisting of prestressed concrete vertical and batter piles, concrete panels between the piles, and concrete pile cap. The king pile system was selected because of the poor soils conditions and the excessive depths required to obtain support for the piles.

In the Aqua Expreso project, a gap in the bulkhead occurs every 30 feet. Each gap is 6 feet wide and 2.83 feet high with a bottom elevation of elevation 0.0 feet and a top elevation of elevation 2.83 feet. These gaps allow for circulation of water through the wall to flood the mangroves behind the bulkhead.

Because of better soil conditions encountered at the eastern Caño Martín Peña project, two channel wall types were considered for the retaining bulkhead, a concrete king pile wall and a steel sheet pile wall. The king pile wall system included 24-inch square prestressed piles placed on ten-foot centers and 6-inch thick precast concrete panels. The piles and panels would be capped with concrete. The sheet pile wall was a cantilevered steel sheet pile wall with a concrete pile cap.

The cost for the two wall systems was approximately the same. However, the cantilevered sheet pile wall was a better system for the following reasons. It would be easier to construct, it would be easier to repair, and it would be less expensive to maintain over the life of the project. Therefore, the steel sheet pile wall was chosen for the eastern Caño Martín Peña bulkhead.

F. Recommended Channel Wall Design

The eastern half of the canal, which extends from the Luis Muñoz Rivera Avenue Bridge to San José Lagoon, is proposed to be widened and deepened. The king pile bulkhead system used for the Aqua Expreso project will not be used for the eastern half. Instead, a cantilevered steel sheet pile wall will be constructed for the eastern bulkhead. Soil conditions for the eastern half of the canal provided greater lateral stability with less penetration, allowing the use of cantilevered sheet pile.

The bulkhead will consist of corrosion resistant steel sheet pile and a reinforced concrete pile cap, which will extend to elevation -2.0 feet. On the north side, the pile cap will be 5.5 feet wide at the top to match the existing pile cap width. The pile cap will be continuous to provide a walkway along the canal. On the south side, the pile cap will be 2 feet wide. Refer to structural Plate S-1 for the typical bulkhead cross section.

The new bulkhead will also be gapped every 30 feet, except on the north side between stations 62+00 and 87+00. Each gap will be 6 feet wide and 2.83 feet high with a bottom elevation of elevation 0.0 and a top elevation of elevation 2.83 feet. The ground behind the bulkhead will be degraded to elevation 0.0 for 10 to 25 feet horizontally and then transition to existing grade using a 1 on 3 slope. As part of the wetland mitigation plan described in the EIS, some mangroves will be planted behind the bulkhead.

On the north side of the canal between stations 62+00 and 87+00, the bulkhead will not be gapped. If the ground behind the bulkhead is greater than elevation 3.0 feet, then it will be degraded to elevation 3.0 feet. A slope of 1 on 3 will be used to transition to existing grade. If the existing ground surface is relatively flat and less than or equal to elevation 3.0 feet, it will be dressed.

G. Soils Data

Refer to the Geotechnical Appendix of this report for core boring and test pit locations, test pit and soils data. Geotechnical tables include the soils data used for the analysis of sheet pile stability and structural design.

Test pit data shows that most of the bulkhead alignment will be free of debris after dredging. The area between Stations 65+00 and 85+00 on the south side might have debris below the proposed channel invert, which could interfere with driving the sheet pile. During the Plans and Specifications phase, additional subsurface investigations would be made at the few sites that might have debris below the proposed channel invert. All debris would be removed prior to installing sheet pile and no debris should remain exposed at the bottom of the channel.

H. Construction Materials

Caño Martín Peña intersects the Río Puerto Nuevo flood control channel at San Juan Bay. Both channels are subject to tidal flow and have approximately the same salinity levels. A study conducted for the Río Puerto Nuevo project provided data showing that chlorides and sulfates are in sufficient concentrations to warrant concern over the deterioration of concrete and steel. Therefore, corrosion resistant materials should be used for the Caño Martín Peña project.

ASTM A690 corrosion resistance (marine grade) steel sheet pile should be used for the bulkhead. The sheet pile should be coated on both sides with a COE 6-A-Z paint system. This paint system consists of white metal blasting and then painting with COE E-303 zinc-rich primer and two coats of COE C-200a coal tar epoxy for a minimum 16-mil coating. The coating would begin 6 inches above the bottom of the concrete pile cap (elevation -1.5 feet) and end approximately ten feet below the dredge line (elevation -20 feet).

Concrete should be of superior quality to mitigate corrosion activity. Shown below is a recommended list to improve durability with respect to sulfate and chloride attack:

1. Use potable quality mixing water. The use of sea water or river water would be prohibited.

2. Use strong, durable aggregates that are free from chlorides, non-alkali reactive, and graded to obtain dense concrete.

3. Use Type I cement with a C3A content less than 10 percent for resistance to sulfate attack.

4. A maximum water-cement ratio of 0.45.

5. Use a water-reducing admixture to improve workability while reducing the water demand at a constant cement content.

6. Use a corrosion inhibiting admixture for resistance to chloride ion penetration, along with adequate cover, to provide maximum protection of the reinforcing steel against chloride attack.

I. Design Criteria

1. Reinforced Concrete

Design was based on the requirements of EM 1110-2-2104, Strength Design for Reinforced Concrete Hydraulic Structures and ACI 318-95, Building Code Requirements for Structural Concrete. The compressive strength used in design of the concrete pile cap was 3000 psi. Steel reinforcement should be ASTM 615, Grade 60.

2. Steel Sheet Pile

Design was base on the requirements of EM 1110-2-2504, Design of Sheet Pile Walls. Sheet piling should conform to ASTM A690, Grade 50.

3. Seismic

The peak ground acceleration coefficient was obtained from Army TM 5-809-10, Seismic Design for Buildings and ASCE 7-95, Minimum Design Loads for Buildings and Other Structures. A peak horizontal ground acceleration coefficient of 0.20 g. was used for the earthquake load case. Refer to CWALSHT User's Guide, Computer Program for Design and Analysis of Sheet Pile Walls by Classical Methods, for the procedure used by the computer program to determine earthquake forces.

4. Design Loading Conditions

Each bulkhead segment was analyzed for two load cases, usual condition and earthquake forces. The bulkhead segments between stations 63+00 and 87+00 on the north side of the canal were analyzed for a third load case, flood condition. None of the three load cases included impact forces from ferries. Refer to structural Plate S-2 for a graphical representation of each load case.

The usual load case included a water surface elevation of 0.0 and a ground elevation of 0.0. Ground surface data was determined from channel cross section drawings. "S" strength soil parameters were used for this load case.

The unusual load case was applicable only to stations 63+00 through 87+00 on the north side of the canal where the bulkhead is not gapped and local floodwaters can collect behind the wall. This load case included water surface elevations of 0.0 on the channel side and elevation 5.0 feet behind the bulkhead. "Q" strength soil parameters were used for this analysis because the fill behind the bulkhead is surcharged by the floodwaters.

The extreme load case was a seismic condition with the same water surface and ground surface elevations as the usual load case. "R" strength soil parameters were used for this analysis.

5. Stability Analysis and Results

A Corps computer program "CWALSHT" was used for the stability analysis of the steel sheet pile bulkhead. Retaining walls criteria, in EM 1110-2-2504 was used to determine passive pressure safety factors for input into the computer model. An active pressure safety factor of 1.0 was used for all load cases. A wall friction angle of 50 percent of PHI was used for the active side. The wall friction angle for the passive side was 50 percent of PHI divided by the appropriate safety factor. A value of zero for soil adhesion was used for all load cases.

Pile tip elevations for each load case were shown in structural Plate S-2. The usual load condition generated the greatest penetration depth for all bulkhead segments. Pile tip elevations ranged from elevation -20.1 feet to -40.0 feet.

6. Stress Analysis and Results

The specified yield stress for the steel sheet pile is 50 ksi. An allowable bending stress for usual load condition is 0.5 times the yield stress. For the unusual load condition, an allowable stress is increased by 33 percent. For an extreme load case, the allowable stress is increased by 75 percent.

The maximum bending moments for the for the usual load condition, unusual load condition and extreme load condition are 54,306 lb-ft, 33,666 lb-ft, and 79,898 lb-ft respectively. The maximum section modulus per foot of wall needed for any of the three load cases is 26.1 cubic inches. Refer to structural Plate S-2 for bending moments by station.

Wall deflections are within acceptable limits. The maximum deflection is 9.37 inches from station 87+00 to 92+00.

J. Utilities

1. General

The recommended project would require the relocation of existing water, sewer, electrical, telephone, and cable TV utilities in the area. Many of the affected utilities are located on the three bridges crossing eastern Caño Martín Peña.

The locations of the affected electrical, telephone, and Cable TV lines along eastern Caño Martín Peña are shown on Plate E1 and Plate E2.

The affected street and trunk sewers are located in a limited area located at the western end of the project in the Hato Rey and Barrio Obrero wards. There are no sewers throughout the rest of the area. The location of the affected water and sewer lines is shown on Plate W-1.

The cost of relocation the affected utilities is currently estimated at $7,511,210. The following sections present details of all affected utilities.

2. Electrical Lines

Electrical lines impacted by channel dredging and bridge replacement are presented below. Conflicts are discussed in order of appearance as one travels west from San José Lagoon along Caño Martín Peña. The location of affected lines is shown on Plates E-1 and E-2. This information is developed from initial coordination performed with the Puerto Rico Electric Power Authority (PREPA). This information has not been completely field verified and will require detailed survey during the plans and specification stage.

The project impacts major electric utilities at the following locations:

(1) The 115kV line crossing Caño Martín Peña and Canal Juan Méndez near their connection with San José Lagoon could be impacted by channel dredging. The support tower on the north bank of the canal, Cantera Peninsula, is close to the canal footprint. Dredging near this tower will require close coordination with PREPA and may require soil reinforcement.

(2) The 4.16kV line crossing the canal along the west side of the Barbosa Avenue Bridge and the 38kV line crossing the canal along the east side of Barbosa Avenue Bridge will be impacted and require temporary and permanent relocation with the replacement of Barbosa Avenue Bridge.

(3) The 4.16kV line crossing Caño Martín Peña from the south-west corner of the Ponce de León Avenue Bridge to the north-east corner of Luis Muñoz Rivera Avenue Bridge will not be impacted by the channel dredging. Support poles on either side of the canal do not fall within the present canal right-of-way.

(4) The 4.16kV and 38kV lines crossing Caño Martín Peña along the west edge of the Luis Muñoz Rivera Avenue Bridge will be impacted and require temporary and/or permanent relocation with the replacement of Luis Muñoz Rivera Avenue Bridge.

In addition to the line crossings identified above, about 438 residential services will require electrical service demolition. Specifically, seven unnamed narrow streets on the south bank, east of Barbosa Avenue at Israel Ward, have multiple residences which will be demolished. Calle 10, 11, 12, 13, and Calle 14 on the north bank at Barrio Obrero Ward, and Calle Pachín Marín, Calle 4, and Calle 5 on the south bank at Hato Rey Ward, have multiple residences which will be demolished. The services feeding these fourteen streets will require new termination.

3. Telephone Lines

Telephone lines impacted by the dredging and bridge replacement are presented below. Conflicts are discussed in order of appearance as one travels west along Caño Martín Peña. This information is developed from initial coordination performed with the Puerto Rico Telephone Company (PRTC). This information has not been completely field verified and will require detailed survey during the plans and specification stage.

The project impacts major telephone utilities at the following locations:

(1) Nine 4-inch PVC conduits and fiber optic cable; Type J, Schedule 40; on the west side of the Ponce de León Avenue Bridge will be impacted by the bridge replacement. Eighteen 4-inch PVC conduits and LDS fiber optic cable on the east side of the bridge. These telephone lines will require temporary and permanent relocation if the Government of Puerto Rico decides to replace the Ponce de León Avenue Bridge. An underground 3-duct liner, 1.25-inch diameter on the east side of the bridge may require re-boring or placement along the bridge to accommodate dredging of the channel.

(2) Nine 32-cable and fiber optic cable across Caño Martín Peña and end pull-boxes, located under the Luis Muñoz Rivera Avenue Bridge, will require temporary and permanent relocation due to channel dredging and bridge replacement.

In addition to the line crossings identified above, services to 438 structures will require demolition. Specifically, seven unnamed streets on the south bank, east of Barbosa Avenue at Israel ward, have multiple residences that will be demolished. Calle 10, 11, 12, 13, and 14 on the north bank at Barrio Obrero Ward, Calle Pachín Marín, Calle 4, and 5 on the south bank at Hato Rey Ward, have multiple residences which will be demolished. The services feeding these streets will require new termination.

4. Cable TV Lines

Cable TV lines impacted by the dredging and bridge replacement are presented below. Conflicts are discussed in order of appearance as one travels west along Caño Martín Peña. This information is developed from initial coordination performed with Cable TV of Greater San Juan. This information has not been completely field verified and will require detailed survey before the completion of the plans and specification stage.

The project impacts major Cable TV utilities at the following locations:

(1) On Ponce de León Avenue Bridge there are: one 0.412 cable and one 0.750 cable suspended on the east side. Eight 1.25-inch diameter quad-loc innerduct flexible inside of two 4-inch diameter galvanized steel pipes and one fiber optic line

cable suspended on the west side. These Cable TV lines will require temporary and permanent relocation if the Government of Puerto Rico decides to replace the Ponce de León Avenue Bridge.

In addition to the line crossings identified above, about 100 residential services will require demolition. Specifically, Calle 10, 11, 12, 13, and Calle 14 on the north bank at Barrio Obrero Ward, and Calle Pachín Marín, Calle 4, and Calle 5 on the south bank at Hato Rey Ward, have multiple residences which will be demolished. The services feeding these fourteen streets will require new termination.

5. Water and Sewer Lines

Water and sewer lines impacted by the channel dredging and bridge replacement are presented below. Conflicts are discussed in order of appearance as one travels west along Caño Martín Peña. This information is developed from initial coordination performed with the Puerto Rico Water Company (PRWC)(former Puerto Rico Aqueduct and Sewer Authority PRASA). This information has not been completely field verified and will require survey before the completion of the plans and specification stage. The location of affected water and sewer lines are shown on Plate W-1.

The project impacts water and sewer utilities at the following locations:

(1) Water lines in seven unnamed narrow streets on the south bank, east of Barbosa Avenue, in Israel Ward. This will necessitate termination and relocation of some water lines affected by the channel right-of-way. To accomplish termination and relocation, a detailed survey will be required of the water lines so that terminations and relocations can be accomplished. Details on terminations and relocations will be developed during the plans and specifications stage.

(2) Twelve inch water line crossing Barbosa Avenue Bridge. This is supported on the bridge and will require relocation during bridge replacement.

(3) Street sewers and water lines east of Calle Pachín Marín and West of the Calle D on the south bank, in Hato Rey Ward. This will necessitate termination and relocation of lines affected by the channel right-of-way. To accomplish termination and relocation, a detailed survey will be required of the street

utilities so that terminations and relocations can be accomplished. Details on terminations and relocations will be developed during the plans and specifications stage.

(4) Street sewers and water lines for Calle 8, 9, 10, 11, 12, 13, 14, and Calle 15 in Barrio Obrero Ward. The 48-inch Rexach Trunk Sewer is located beneath Calle 13 and will be impacted by the channel dredging. This will necessitate termination and relocation of lines affected by the channel right-of-way. To accomplish termination and relocation, a detailed survey will be required of the street utilities so that terminations and relocations can be accomplished. Additionally, the channel dredging will effect portions of the 48-inch Rexach Trunk Sewer. The relocation of Rexach Trunk Sewer will require coordination with the relocation of the 66-inch Rexach crossing described below. Details on terminations and relocations will be developed during the plans and specifications stage.

(5) The channel dredging will impact the 66-inch Rexach crossing. This is a large crossing joining streets on separate north and south banks of the Caño Martín Peña. The line is shallow and compromises the final invert of the channel. The top of the pipe is at elevation -7.00 feet and the channel dredging is at elevation -10.00 feet. It will be impossible to dredge around the Rexach crossing and leave it in place since there will be impacts to the channel sheet pile wall and to its hydraulics. In addition, DNER and USACE standards proscribe a line to be 6 feet below a channel. However with large lines this requirement is problematic. The relocation of the Rexach crossing will require extensive engineering design to provide a multi-barreled siphon that is routed 6 foot below channel depth.

Siphons can be constructed of several materials. Historically, they have been constructed of reinforced concrete or ductile iron pipe encased in concrete. The reinforced concrete encasement is required to prevent joint leakage of sewage contamination of the water. This increases the weight of the crossing and requires support piles. This construction is expensive requiring driven pile foundations and cofferdam construction. Within the last 10 years, this type of construction has been replaced with High-Density polyethylene (HDPE) plastic pipe. The joints are thermoplastically welded and this provides protection against leakage. They are flexible and can be stretched without joint failure. Therefore, concrete encasement is not required. The weight is substantially reduced and pile and cofferdam construction is not required. Therefore, this should be the chosen construction method for relocation. Also, the presence of so many structures and underground utilities in a constrained site demand the use of a very flexible pipe to be used for the relocation. Several barrels would be required to provide the equivalent hydraulic capacity.

The crossing will entail an inlet and outlet structures and diversion manholes. The siphon barrels will be laid a minimum of 6 feet below the channel. Diversion structures/manholes will be constructed upstream of the existing crossing and sewage diverted to the new siphon. This construction will require coordination with the relocation of the 48-inch Rexach Trunk as identified before.

(5) The channel dredging will impact the Boriquen Water line. This a 36-inch crossing located several hundred feet north of the Ponce de León Avenue Bridge and is lay down very shallow (with about three feet of cover). This water line can be relocated by a variety of methods and pipe materials. A HDPE relocation would be feasible but would require multiple barrels and a determination of the service pressure of this pipe. This will require extensive engineering beyond this discussion. This water line could be relocated in conjunction with the twin water lines at Ponce de León Avenue. The exact relocation design will be determined during the plans and specifications stage.

(6) Twin Water lines at Ponce De León Avenue Bridge could be impacted by the potential bridge relocation. These lines comprise of two 20-inch water lines supported under the deck of Ponce De León Avenue Bridge. These water lines will require permanent relocation if the Government of Puerto Rico decides to replace the Ponce de León Avenue Bridge.

K. Bridges and Roads

The recommended project proposes replacement of existing bridges at Luis Muñoz Rivera Avenue and Barbosa Avenue mainly to lower bridge foundation elevation below -10.0 feet, to increase vertical water clearance, and to increase horizontal clearances of bridge spans. These clearances are also required to facilitate dredging the canal from the water and clearances would allow for future safe navigation.

It was found that the elevation of the pile caps for the Ponce de León Avenue Bridge will allow for up to 8 feet deep channel excavation. Because the channel widens here to provide adequate flow area, this depth under the bridge will provide the tidal flushing required for the improved canal. Therefore, replacement of the Ponce de León Avenue Bridge is not proposed as part of the recommended project. The Ponce de León Avenue Bridge would, however require relocation for safe navigation if ferry boat traffic is contemplated because of its limited vertical water clearance of 10.2 feet.

Appendix C, Bridge Replacement Requirements, provides details on existing bridges, design constraints and assumptions, structural bridge design, roadway improvements, maintenance of traffic considerations, right-of-way, utility relocation, and cost estimates.

As part of this report, conceptual level bridge replacement designs were developed for all three bridges. Although maximum water quality benefits could be obtained by only replacing the Barbosa Avenue and Luis Muñoz Rivera bridges it was agreed that cost estimates would be developed for the replacement of all three bridges. Bridge designs were developed with the assumption that the minimum low chord clearance would be 20 feet to facilitate channel dredging and the expansion of ferry service to the Airport and Carolina area at some time later.

Specifics as to how the bulkhead will connect to the various bridge abutments would be completed after bridge plans have been finalized during the Plans and Specifications phase.

L. Stockpile and Staging Areas

The recommended project includes three temporary staging and/or stockpile areas to be used during project construction for storing equipment and construction supplies. The locations of stockpile and staging areas are shown on Plate 1 and Plate 2.

Staging Area number 1 is located on the south central portion of the project area in Hato Rey. Staging Area 1 covers 5.0 acres.

Staging Area number 2 is located on an existing baseball field and dead-end street on the southeast end of the project area in Israel. Staging Area 2 covers 1.5 acres.

Staging Area number 3 is located on lands belonging to the Roberto Clemente Sports City. Staging Area 3 covers 5 acres of upland that would be adequate for use as a stockpile area for the debris material, as referred to in Section VI.D. and Section IX.D., and for stockpiling the material to be used to cover the in-bay disposal areas. The contractor could also use this area as a staging area for equipment and construction supplies.

X. COST ESTIMATES

The estimated cost for construction of the recommended project at November 1999 price levels, including replacing two bridges, is $111,200,786. A cost estimate summary is presented in Table 2. Appendix E, presents the detailed cost estimates. These costs include $50.0 million for channel dredging and material disposal, $1.9 million for recreation features, $7.5 million for utility relocation, $9.6 millions for bridge replacement, $34.5 millions for land acquisition, $3.6 million for planning, engineering, and design, and $4.1 million for construction management. Details on bridge replacement costs are presented in the Appendix C, Bridge Replacement Requirements.

XI. PLAN OF ACTION FOR PROJECT IMPLEMENTATION

It is recommended that after consultation and coordination with all concerned Federal and local public agencies as well as the residents of the project area, a Plan of Action for the implementation of the recommended project should be prepared.

Table 2

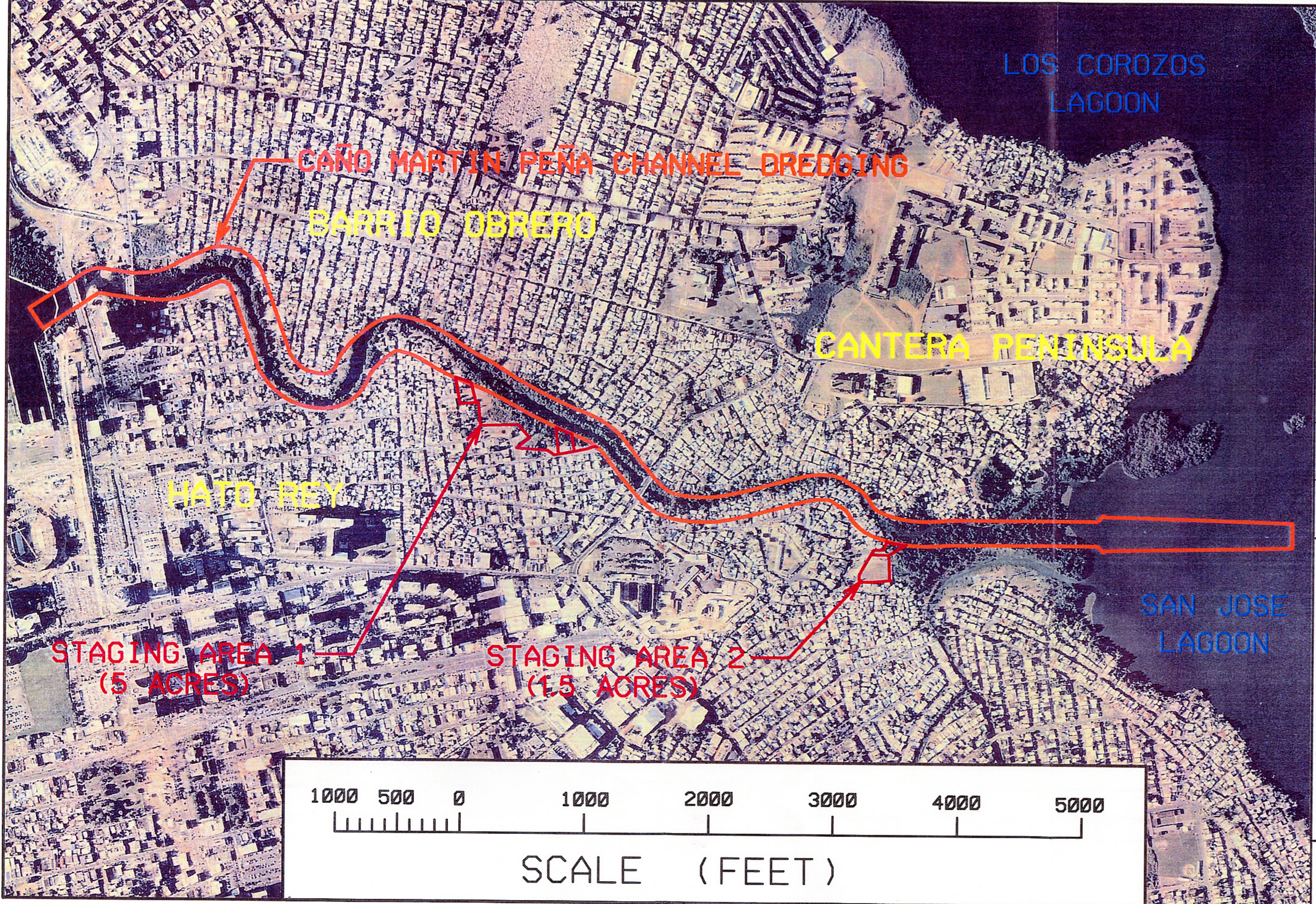
Caño Martín Peña, Puerto Rico
Design Memorandum

Summary Cost Estimate
Recommended Project

ITEM	COST
Channel Dredging/Disposal	$ 49,978,827
Relocation of Utilities	$ 7,511,210
Recreation Facilities	$ 1,875,374
Real Estate	$ 34,519,375
Planning, Engineering, Design	$ 3,564,000
Construction Management	$ 4,152,000
Replace Jose C. Barbosa Bridge	$ 3,600,000
Replace Luis Muñoz Rivera Bridge	$ 6,000,000
TOTAL COST	$111,200,786

DREDGING OF CAÑO MARTÍN PEÑA
PUERTO RICO
FINAL
PROJECT DESIGN REPORT AND
ENVIRONMENTAL IMPACT STATEMENT

PLATES



US Army Corps of Engineers
Jacksonville District

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

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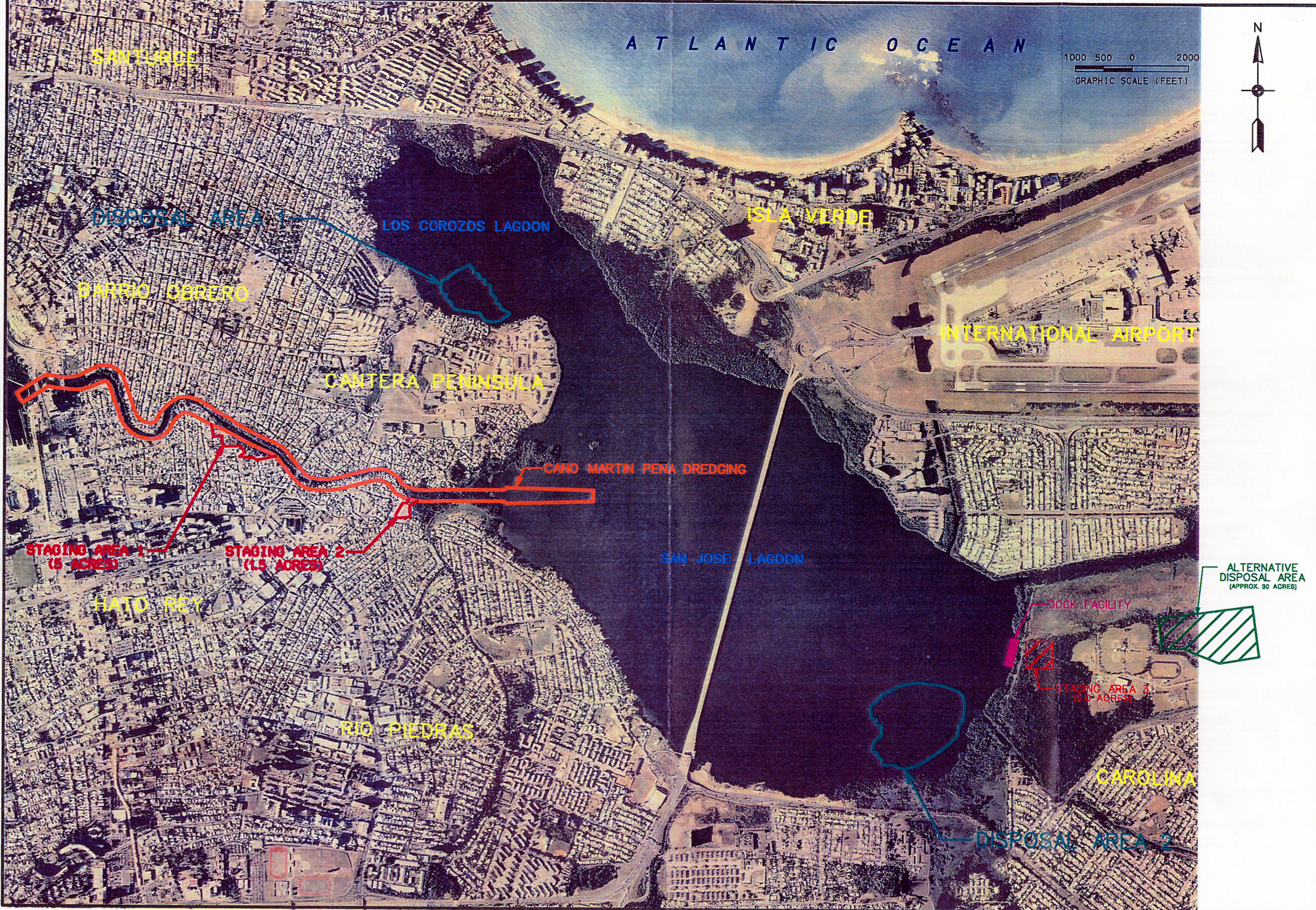
		Plot scale:
Dated:		
D.O.FILE NO.		

File name: plate1.dgn
Reference files: x230plan.dgn mpendwg.dgn chan99.dgn dmltx17.dgn staging.dgn

CAÑO MARTIN PEÑA, PUERTO RICO
PROJECT DESIGN REPORT
RECOMMENDED PROJECT
STAGING AREAS LOCATIONS
DECEMBER 2000

PLATE
1



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Jacksonville District

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JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

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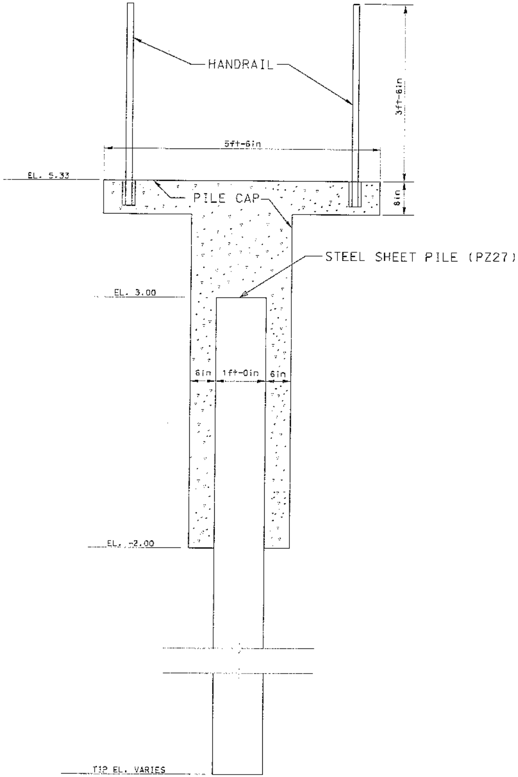
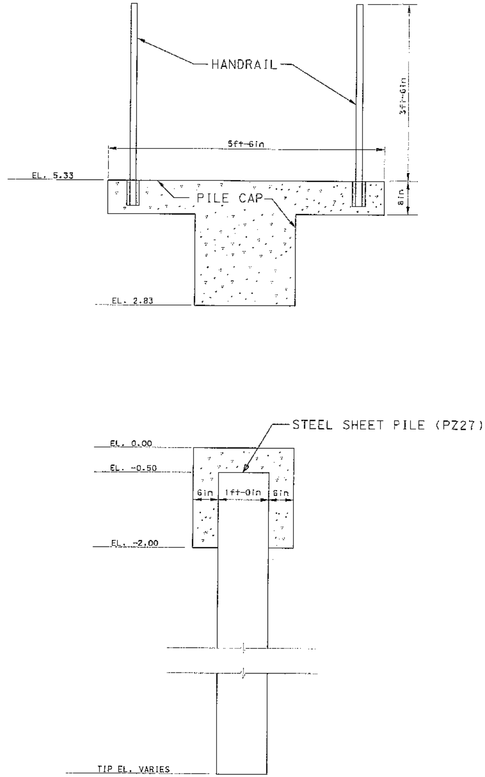
CAÑO MARTIN PEÑA, PUERTO RICO
PROJECT DESIGN REPORT
RECOMMENDED PROJECT
DISPOSAL AND STAGING AREAS LOCATIONS
DECEMBER 2000

PLATE
2



TYPICAL BULKHEAD CROSS SECTION



TYPICAL BULKHEAD CROSS SECTION @ GAP

US Army Corps of Engineers
Jacksonville District

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

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File name: PLATE1.DGN

D.O. FILE NO.

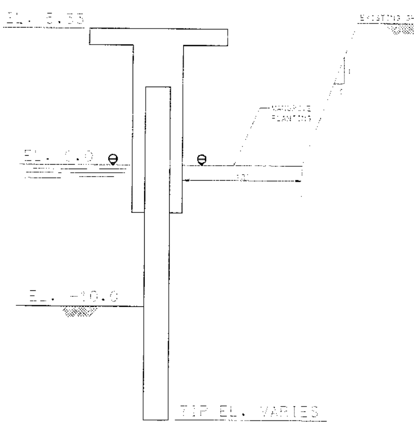
SAN JUAN, PUERTO RICO
MARTIN PENA CHANNEL IMPROVEMENTS
DESIGN MEMORANDUM
TYPICAL BULKHEAD CROSS SECTIONS
STRUCTURAL

PLATE
S-1

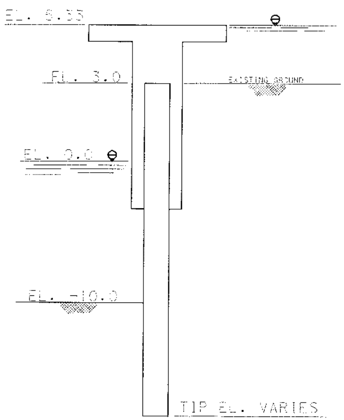
STATION	USUAL CONDITION			UNUSUAL CONDITION			EXTREME CONDITION		
NORTHSIDE	PILE TIP EL.	M max (lb-ft)	DEFLECT. (in)	PILE TIP EL.	M max (lb-ft)	DEFLECT. (in)	PILE TIP EL.	M max (lb-ft)	DEFLECT. (in)
4+00 - 10+00	-20.5	6,573	0.35				-12.1	631	0.02
10+00 - 20+00	-24.8	12,329	0.90				-14.2	4,140	0.10
20+00 - 34+00	-24.0	11,178	0.77				-13.6	3,901	0.09
34+00 - 41+00	-25.8	12,305	0.96				-15.5	4,364	0.13
41+00 - 54+00	-32.8	26,759	3.20				-27.2	20,026	1.76
54+00 - 63+00	-33.0	46,881	5.39				-27.5	41,843	3.13
63+00 - 77+00	-22.8	8,983	0.57	-18.6	31,935	1.41	-13.7	4,938	0.11
77+00 - 81+00	-20.1	8,690	0.40	-17.0	33,666	1.27	-13.7	5,460	0.12
81+00 - 87+00	-21.9	22,158	1.42	-17.2	27,166	1.05	-17.2	19,215	0.72
87+00 - 92+00	-40.0	54,306	9.37				-35.0	73,867	8.64
92+00 - 101+00	-37.0	34,660	5.07				-32.8	50,040	5.01
SOUTHSIDE									
3+00 - 8+00	-22.4	8,858	0.56				-12.9	4,510	0.08
8+00 - 15+00	-20.8	10,032	0.52				-20.6	6,240	0.37
15+00 - 30+00	-28.8	26,883	2.60				-13.6	3,917	0.09
30+00 - 33+00	-26.1	15,766	1.28				-17.6	15,019	0.60
33+00 - 50+00	-31.1	26,727	2.97				-20.8	14,611	0.69
50+00 - 64+00	-29.6	36,589	3.48				-23.3	23,538	1.28
64+00 - 81+00	-22.1	11,060	0.66				-14.3	6,680	0.16
81+00 - 87+00	-17.5	5,786	0.22				-13.4	4,927	0.10
87+00 - 101+00	-38.2	42,635	6.76				-36.7	79,898	10.50

Table title: SUMMARY OF RESULTS

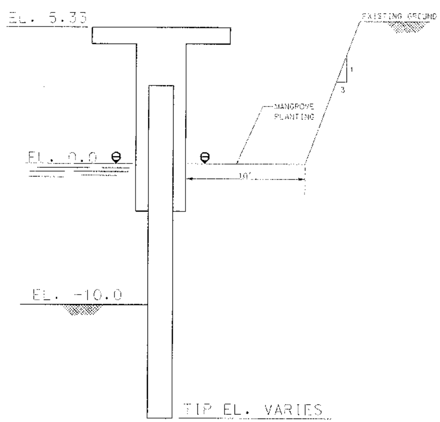
USUAL LOAD CASE
NORMAL WATER SURFACE LEVEL



UNUSUAL LOAD CASE
FLOOD CONDITION



EXTREME LOAD CASE
EARTHQUAKE LOAD



US Army Corps of Engineers
Jacksonville District

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

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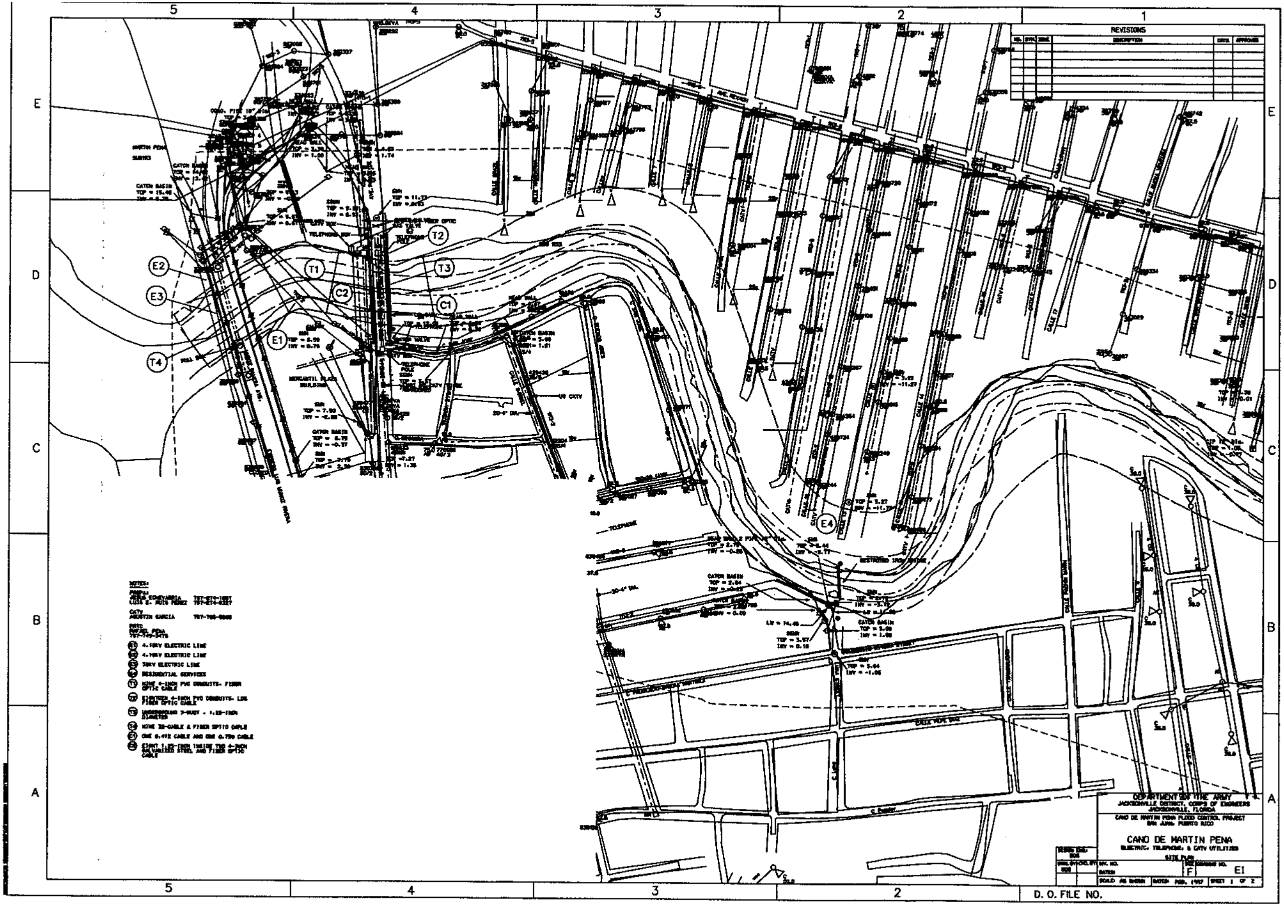
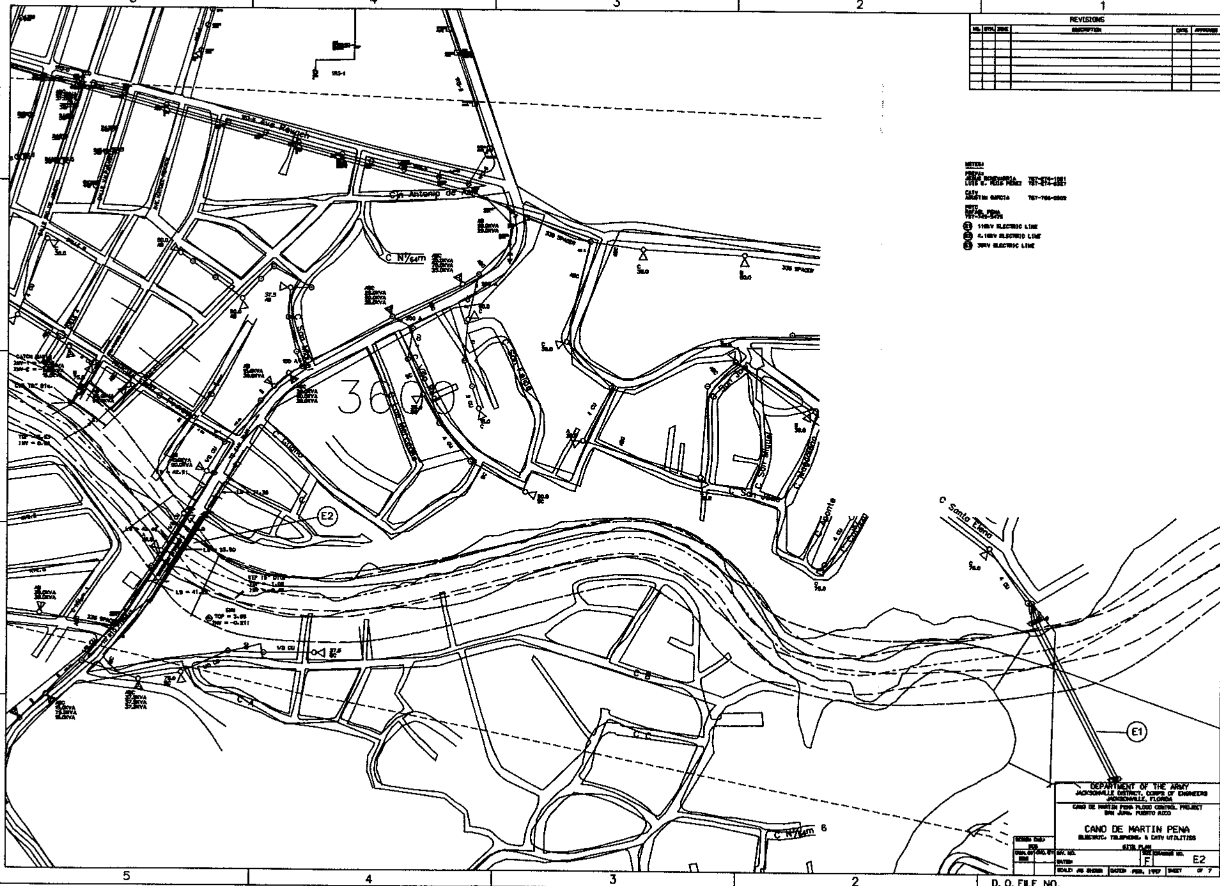
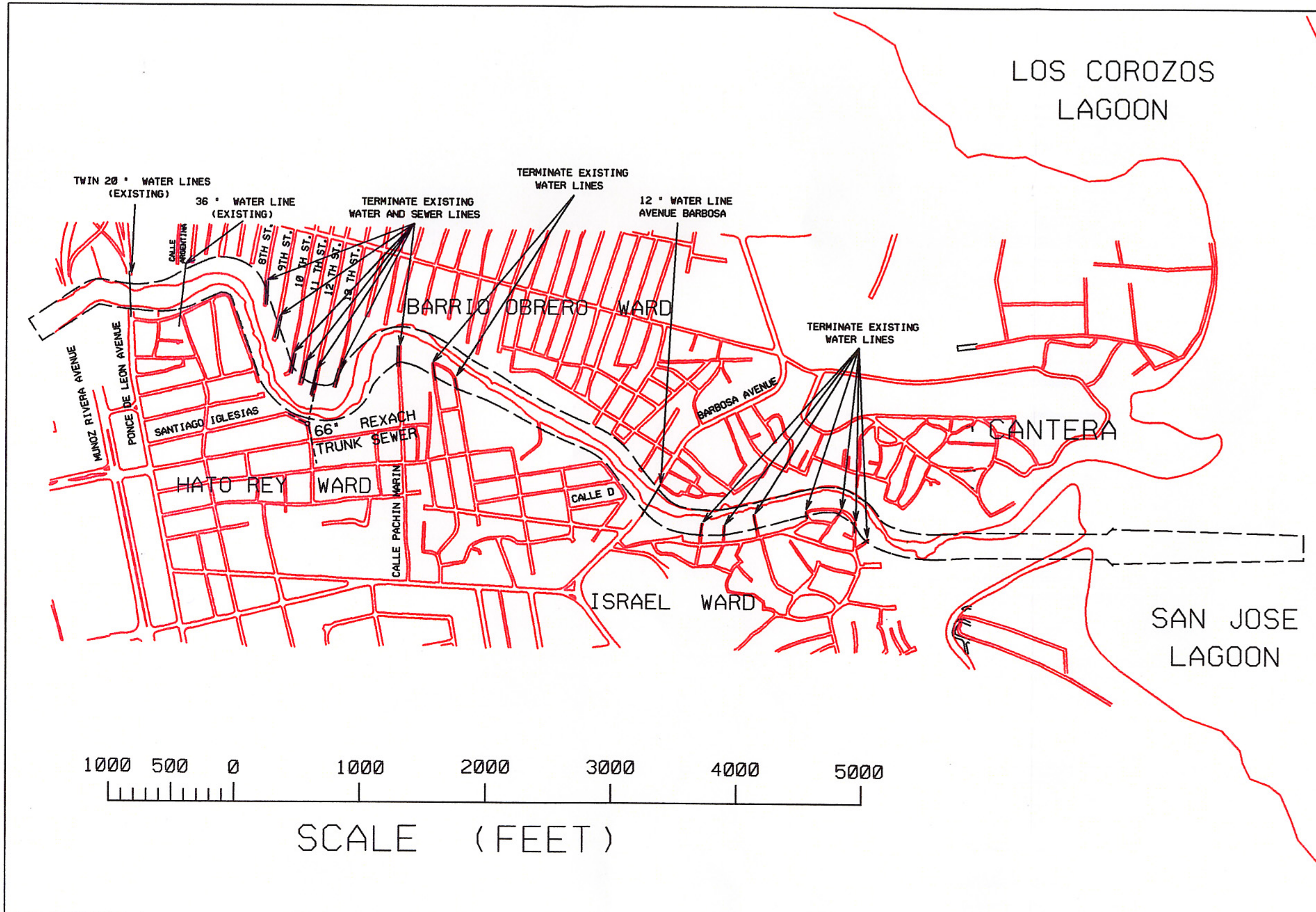
File name: PLATE2.DGN
D.O.FILE NO.

SAN JUAN, PUERTO RICO
MARTIN PENA CHANNEL IMPROVEMENTS
DESIGN MEMORANDUM
ANALYSIS SUMMARY
STRUCTURAL

PLATE
S-2


REVISIONS
T1
T2
T3
T4
C1
C2
E1
E2
E3
E4
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
CANO DE MARTIN PENA FLOOD CONTROL PROJECT
SAN JUAN, PUERTO RICO
CANO DE MARTIN PENA
ELECTRIC, TELEPHONE, & CATV UTILITIES
SITE PLAN
F
E1
SCALE: AS SHOWN
SHEET 1 OF 2
D. O. FILE NO.


REVISIONS
C Santa Elena
C San Jose
C Guamo
C N1/64m
C N1/64m 6
C B
C A
E1
E2
3600
DEPARTMENT OF THE ARMY
CANO DE MARTIN PENA
F
E2
D. O. FILE NO.



US Army Corps of Engineers Jacksonville District

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

D.O.FILE NO.

CANO MARTIN PENA, PUERTO RICO
PROJECT DESIGN REPORT
WATER AND SEWER UTILITIES
LOCATION OF UTILITIES AFFECTED BY PROJECT
DECEMBER 1999

PLATE
W-1

DREDGING OF CAÑO MARTÍN PEÑA
PUERTO RICO
FINAL
PROJECT DESIGN REPORT AND
ENVIRONMENTAL IMPACT STATEMENT

ENCLOSURES

DNER

DEPARTMENT OF NATURAL AND ENVIRONMENTAL RESOURCES

October 3, 1995

COL Terrence Rice
Commander
U.S. Army Engineer District
Corps of Engineers
400 West Bay Street
Jacksonville, FL 32232

Dear Colonel Rice:

The purpose of this letter is to request you prepare for us, under the authority of Support for Others Program, the design memorandum for the dredging of the Caño Martín Peña from Muñoz Rivera Avenue to its confluence with the San José lagoon.

The requested work should follow the Martín Peña Canal Project Management Plan prepared under Section 22 Planning Assistance to States for the Corporation for the Development of the Cantera Peninsula. Though the main purpose of the dredging at this moment is environmental enhancement and facilitate the area's redevelopment, the Government of Puerto Rico intends to extend in the future the Agua/Guagua service along the entire canal. To that effect, the design should be consistent with that purpose.

There are two important elements of the design that demand particular attention. The first relates to the necessary lands, easements, rights-of-way, and relocations for the implementation of the project together with necessary development of new utilities facilities (sewer) in the area for the project to be effective while the second refers to developing acceptable and viable alternatives for disposal of dredge materials. Also, the design should not contemplate replacing the bridges at this moment.

During the last ten years considerable planning efforts and field data collection have been undertaken by several local and federal agencies for the study area. Some of this information is being updated and expanded through different programs, such as the San Juan Bay Estuary Program and the Environmental Quality Board Water Quality Program. All this information should prove very helpful in the development of the design memorandum.

Muñoz Rivera Ave., Stop 3 1/2, San Juan, P.R. / Box 5887, Pta. de Tierra Station, P. R. 00906 / Tel. (809) 724-8774

The design memorandum should be developed during the next two fiscal years (FY's 96-97). Maximum budgeted funds for the work is $1,000,000 with $400,000 already appropriated for FY-96. It is expected that the implementation of the project would involve federal funds. Mr. José A. González Liboy, Administrator of the Natural Resources Administration of the Puerto Rico Department of Natural and Environmental Resources, is the POC for the preparation of the MOA and the scope of work. He will also preside over an interagency and community committee that will oversight the development of the work.

Thank you very much for your prompt attention to this request.

Sincerely,

Pedro A. Gelabert
Secretary

CF:
Secretary, DTPW
Secretary, PR Housing Dept.
President, PR Planning Board
President, PR EQB
Director, SJ Bay Estuary Program
Director, PRASA
Director, PREPA
Director, PR OBM
Director, Corporación Desarrollo Cantera
Mayor, Municipality of San Juan
Administrator, NRA

l:rice

DRAFT ENVIRONMENTAL IMPACT STATEMENT

MARCH 2001

DREDGING CANO MARTIN PENA FOR ENVIRONMENTAL RESTORATION SAN JUAN, PUERTO RICO

LEAD AGENCY: Puerto Rico Department of Natural Resources

COOPERATING AGENCIES: Puerto Rico Department of Public Works, Puerto Rico Aqueduct and Sewers Authority, Puerto Rico Planning Board, San Juan Bay Estuary Program

At the request of agencies of the Commonwealth of Puerto Rico, under its Support for Others authority, the U.S. Army Corps of Engineers developed a plan to dredge and dispose of dredged material from Caño Martín Peña to improve water circulation and quality in this water body and the San Juan Bay Estuary system. The proposed action is dredging and building a vertical walled channel, 150 to 230 feet wide, to an average 10 foot depth, along 11,600 feet of the eastern channel. The project would increase flushing of contaminants, conserve and restore wetlands and also include increased recreation access to the Channel, which has become almost totally plugged by sediment and debris accumulation. Dredged material would be deposited in existing deep holes in San Jose or Los Corozos Lagoon and capped with clean material. Dredging the Channel would also restore shallow draft navigation to the eastern Channel and part of San Jose Lagoon. Federal Permits will be required for the proposed work under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act, as amended. This Draft Statement was prepared at the request of Cooperating Agencies to support a permit application to the U.S. Army Corps of Engineers, although at this time no permit application has been initiated.

For more information, contact Esteban Jiménez, U.S. Army Corps of Engineers, Planning Division, P.O. Box 4970, Jacksonville, Florida 32232-0019, phone (904) 232-2115, or facsimile 232-3442.
In order to be considered in the next revision of this D-EIS, your comments must be received by the date shown on the letter of transmittal from the Lead Agency.

U.S. Army Corps
of Engineers
Jacksovnille District

DRAFT ENVIRONMENTAL IMPACT STATEMENT DREDGING EASTERN CANO MARTIN PENA FOR ENVIRONMENTAL RESTORATION, SAN JUAN, PUERTO RICO

EXECUTIVE SUMMARY

Project Description. The Puerto Rico Department of Natural and Environmental Resources, representing the Government of the Commonwealth of Puerto Rico (called DNER hereafter), requested the U.S. Army Corps of Engineers (Corps) to develop, under its Support for Others authority, a plan and Draft Environmental Impact Statement for dredging the easternmost 11,600 feet of Caño Martín Peña (called CMP hereafter) to improve water flow from coastal lagoons east of San Juan Bay, through the Channel, and into the Bay itself. The Federal Action involved is issuance of Federal Permits under Section 10 of the Rivers and Harbors Act of 1899, as amended and Section 404 of the Clean Water Act of 1972, as amended. The objective of the proposed project is to improve water quality in the Channel and the San Juan Bay Estuary System. The project would consist of a rectangular channel, 11,600 feet long, 10 feet deep and 150 to 230 feet wide. The vertical channel wall would be supported by concrete faced steel sheet piles. The Channel design would be similar to the western half of CMP, built in 1987, except that instead of using concrete piles and panels (king pile wall), the eastern bulkheads would consist of steel sheet pile, faced and capped with concrete to resist corrosion. Gaps will be left in the vertical bulkheads to provide for tidal flushing, as was done in western CMP. In order to achieve full water quality improvements, two existing bridges that span the eastern channel (at Avenida Muñoz Rivera and Avenida Barbosa) would need to be replaced, along with the "Rexach" sewer, which presently passes under the Channel at a shallow depth. The project would affect a total of 47.8 acres of wetlands, decreasing mangrove cover and increasing open water area, volume and quality. The plan proposes replacing the 8 acres of mangroves removed by creation of about 9 acres of mangroves behind the vertical pile channel walls. Initial assessment of the quality of affected mangrove stands using the "E-WRAP" method indicates that this mitigation is more than adequate to account for wetlands functional losses. About 438 residences, an unknown but small number of businesses, and some local branches of water and sewer lines, power, television and telephone cables, will also require replacement. Dredging would generate an estimated 750,000 cubic yards of material for disposal. The recommended disposal method is in-lagoon disposal and capping with clean material. Materials excavated from the channel footprint would be barged to two deep holes in the bottom of Los Corozos and San José Lagoons, where they would be deposited, and then capped with select fill. This disposal alternative should facilitate long-term water quality improvement in San José lagoon by eliminating deep, anaerobic holes and allowing wind mixing.

Need or Opportunity. Caño Martín Peña (CMP, or Martín Peña Channel, in English) is a shallow, narrow, winding and heavily polluted tidal channel that separates the wards of Santurce and Hato Rey in San Juan, Puerto Rico. Until about 1949 it was 200-400 feet wide. Since then it has gradually narrowed and filled in due to a combination of unauthorized fill, natural sediment accumulation and debris disposal, in a microtidal environment. There is almost no water movement or tidal flushing at present, and waters are black, with low dissolved oxygen, high nutrient levels and high indicator bacteria counts. In its present condition the eastern Channel is a choke point or plug to the free flow of water through the greater San Juan lagoon-estuary system. The San Juan Bay Estuary Program (SJBEP) identified blockages of CMP as a constraint that will limit water quality improvement of the greater San Juan estuaries, based on model studies done for that Program. Improving CMP is a long-standing policy and goal of the Puerto Rico and San Juan Municipal governments. It is an official strategy for overall water quality improvement in the Estuary Program's Comprehensive Conservation and Management Plan, published in 1999.

The DNER requested the design and planning assistance of the U.S. Army Corps of Engineers (USACE) to develop and evaluate alternatives for improving eastern CMP. To assist development of effective alternatives USACE used the hydrodynamic and water quality models developed by the U.S. Army Engineers Waterways Experiment Station (WES) for SJBEP. Various dredging scenarios or alternatives were evaluated for their potential to improve water quality inside CMP, in San José Lagoon, and in inner San Juan Bay. In addition to the no-action alternative, three scenarios were presented to the applicant by USACE. The DNER's preferred alternative is a vertical-walled channel as described above. This D-EIS presents DNER's preferred alternative as the "recommended alternative," because it is the alternative recommended by the Corps team and preferred by the DNER as most likely to maximize water quality improvement while minimizing adverse environmental impacts. Since at the moment there is no Federal action pending, this D-EIS will support Commonwealth of Puerto Rico decision-making processes as an interagency discussion and decision document.

Major Findings and Conclusions. Construction of the project features discussed in this Report and D-EIS would result in water quality improvement in CMP, San Jose and Los Corozos Lagoons and, to a lesser degree, in inner San Juan Harbor. Wetlands habitat (mangroves) along the channel margin would temporarily decrease in cover during construction, as dredging the channel to full width would convert mangrove-covered sediments to open water. This habitat would be replaced on site under the recommended alternative after the sheet pile wall is installed and the mitigation sites are planted. Aquatic habitat quality (habitat for fish and invertebrates) s very poor at present. It is expected to improve under all alternatives, both in the channel and in San Jose lagoon, as the deepest anoxic holes are filled and capped. Disposal of dredged material in San Jose and Los Corozos Lagoons will not cause violation of existing water quality standards. Furthermore, once all the Lagoon holes are filled, capped, and brought back up to the overall lagoon bottom elevation, the lagoon's waters will be more readily mixed and re-aerated by the wind, and its water quality should show significant improvement. A Water Quality Certificate will be applied for to support the application for a U.S. Army Permit.

Adverse impacts would include the following.

Existing infrastructure replacement. In order to realize significant circulation benefits from dredging, two bridges (at Avenidas Muñoz Rivera and Barbosa) need to be replaced, at an estimated cost to the Commonwealth of Puerto Rico, of 10 million dollars. The 66" diameter Rexach Avenue sanitary sewer siphon under CMP will also require replacement, because it is buried at a depth too shallow to allow for dredging. Additional stretches of water and sewer lines, television and telephone cables and power lines will require replacement. Infrastructure replacement costs, excluding bridges, are estimated at about $7.5 million. Replacement of all infrastructure elements is expected to require several years. These infrastructure replacements are a significant part of the total project cost, but without them the environmental benefits of dredging would be slight and short-lived.

Wetlands Impacts: The recommended alternative would directly affect 47.8 acres of wetlands, including open water and fringing mangroves. Open water area would increase and water quality would improve, under this alternative. Significant positive secondary impacts of the project include water quality improvements in San José Lagoon and San Juan Bay. Eight acres of mangrove wetlands would be removed by dredging. Proposed mitigation consists of replacing 9 acres by (re)creation of tidal wetland behind the sheet-pile walls. The remaining mangroves (those not excavated for the channel), will be reconnected to tide. A "lost panel" design would provide regularly spaced gaps for tidal flushing behind the bulkhead. This design is similar to the one used successfully in the western CMP project. A "desktop" evaluation, using the "Estuarine Wetlands Rapid Assessment Procedures' (E-WRAP) resulted in a score of 0.33 for these wetlands (existing conditions). Planned mitigation is believed to be in excess of minimal requirements.

Impact on residents: The recommended alternative would require relocation of about 438 residences and a small but unknown number of small businesses in a low income community. The residences to be removed are in extremely flood-prone areas. Offsetting the adverse effect on these residences, a much larger number of residences adjoining the channel would be provided some additional stormwater storage capacity (in the improved channel) and consequent alleviation of short-duration, runoff-related flooding. Thousands of other residents would benefit from water quality, aesthetic and infrastructure improvements. Channel improvements would not sever communities from each other, or preferentially affect particular low-income population segments. Recreation features to be added to the channel include a walkway/bikeway atop the concrete pile cap, and access points for fishing or other passive recreation.

This proposed action is in the National interest and can be constructed while protecting the human environment from unacceptable impacts. Benefits of the proposed action would be improved water quality, fish and wildlife habitat, public health, and aesthetics of the channel margin. Associated recreational development (proposed bike and jog path and access points) will provide additional recreational opportunities of a type not currently available to the residents of adjoining neighborhoods. Dredging the eastern half of Martín Peña would provide the potential for developing a navigation project in the future, should this appear desirable. Measures taken to avoid, minimize, and compensate for adverse impacts include: (a) avoidance of the historically significant bridge at Avenida Ponce de Leon; (b) creation of substitute mangrove wetlands to replace mangrove wetlands required for the widened channel footprint; (c) minimizing loss of existing mangroves, through provision for tidal flushing of wetlands behind the sheet pile panels; (d) avoidance, to the maximum extent possible, of adverse impact on waters and wetlands through selection and development of a disposal alternative that would immobilize dredged material under a cap in existing deep, anoxic holes in San Jose Lagoon.

Alternatives. Alternatives evaluated include no-action, a minimal dredge alternative with in-Lagoon disposal, a trapezoidal (sloping side wall) earthen channel dredge alternative with in-Lagoon disposal, and a vertical-walled channel dredge alternative with in-Lagoon disposal. No other alternatives for dredging were developed. Additional disposal alternatives for dredged material include upland disposal, landfill disposal, and disposal in an especially built landfill over adjacent wetlands. Materials proposed for dredging and excavation are not eligible for marine disposal.

Recommended Alternative(s). The recommended dredging alternative is to construct a vertical walled channel with a depth of up to10 feet, lined by steel sheet pile with a corrosion resistant concrete facing, through the easternmost 11,600 feet of Martin Peña Channel. Channel width would vary between 150 feet, in relatively straight stretches, to a maximum of 230 feet at the tightest curve and at the Ponce de Leon Bridge cross-section. The sheet pile wall would be provided regular gaps to allow tidal flushing of adjacent mangroves. Dredging would generate about 750,000 cubic yards of material for disposal. The preferred disposal alternative for the material is deposit in deep holes in Los Corozos and San Jose lagoons, to be capped, after filling, with clean material. Dredging would proceed from the eastern end of San Jose Lagoon westward into CMP and would be accomplished by a clamshell or other mechanical dredge mounted on a barge. Dredged material would be transported on barges to the disposal site. This method of disposal may also require dredging a small channel across Laguna San Jose to provide barge access. Three small staging areas for sorting dredged material and removal of large pieces of trash would also be required. The

Barbosa Avenue Bridge, the Luis Muñoz Rivera Bridge, the Rexach Avenue sewer crossing, and associated infrastructure elements, would have to be replaced prior to beginning the dredging project. About 438 residences would require relocation. The preferred alternative is shown on Main Report Plate 2.

Issues Raised by the Public and Agencies. At this time the following issues are known to be of concern to the public and resource agencies:

Size of the channel: commenting natural resource agencies have questioned the need for a "maximal" channel to provide adequate flushing. Some agencies have questioned whether a somewhat smaller channel would not be equally effective, given the microtidal regime. In response to this issue, the preferred channel design was based on results of a hydrodynamic circulation model developed for the San Juan Bay Estuary Program by the U.S. Army Corps of Engineers Waterways Experiment Station (WES) in Vicksburg, MS. Results showed that either the trapezoidal shaped or the vertical walled channel would provide effective mixing, but that the vertical walled channel provides a greater effective cross section, potentially maximizing water quality improvements.

Wetlands impacts: commenting agencies recommended avoidance, to the maximum extent possible, of adverse effects on mangrove wetlands. US Fish and Wildlife Service, US Forest Service, and National Marine Fisheries Service raised this concern. In response to this concern, the recommended project design avoids mangrove wetlands where possible and builds in full replacement acreage for those areas of mangrove that must be removed to achieve the design cross section. The minimal clean-out alternative would impact a lesser area of mangroves but would not be effective in water quality improvement. In response to resource agency concerns about mangrove root community losses, the mangroves lining CMP are devoid of these communities, due to the anoxic condition of the Channel's waters.

Environmental Justice: about 438 residences would be in the footprint of the improved channel. These residences lie along the outside of the tightest meander loop in the central part of the channel, and along the south bank, east of the existing Barbosa Avenue bridge. The majority of area residents, both potential beneficiaries and residents subject to relocation, are from the same low-income segment of the community. Many potentially affected residents have already participated in community meetings where the project was discussed. However, not all affected residents may yet be aware of the potential effects of this plan. That is one reason that the applicant wants to begin the environmental review process at this time.

Areas of Controversy and Unresolved Issues.

The remaining area of controversy revolves around removal of mangrove stands to widen the channel. The mangroves to be removed are growing on the sediment plugs that have narrowed the channel, and widening/deepening cannot be accomplished without this removal. It is the Corps' belief that adequate mitigation is provided for adverse effects. Mangrove wetlands will be restored, leading to a with-project increase in overall mangrove acreage, and water quality will improve both inside and outside Martín Peña, as a result of widening and deepening the channel. At this time there are no other unresolved issues. Coordination of this Environmental Impact Statement will assist in resolution of the remaining controversy.

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1 PROJECT PURPOSE AND NEED

1.1 PROJECT AUTHORITY.

FEDERAL AUTHORIZATION.

The US Army Corps of Engineers (Corps hereafter) regulates excavation, dredging and disposal activities in navigable waters of the United States under Section 10 of the Rivers and Harbors Act of 1899, as amended, and regulates the discharge of dredged or fill materials into the waters of the United states under Section 404 of the Clean Water Act of 1972, as amended, in coordination with other Federal agencies including the US Environmental Protection Agency. The action discussed in this Statement is subject to USACE regulation under the above Laws. It is also subject to Commonwealth of Puerto Rico laws and regulations, Including the Commonwealth Environmental Policy Law and its Environmental Impact Statement Regulation. This Statement was written to document both the proposed future Federal Action (issuance of a permit) and the required Commonwealth of Puerto Rico approvals, permits and concurrences required.

This report discusses a prospective future Federal regulatory action, namely, issuance of an Individual Permit to the Applicant for the action discussed hereunder, and a proposed Commonwealth of Puerto Rico action, namely, commitment of funding for, followed by construction of, the described dredging project, primarily as an environmental improvement, with secondary purposes of flood mitigation and potential navigation.

COMMONWEALTH OF PUERTO RICO AUTHORIZATIONS

The Puerto Rico Department of Natural Resources (DNER hereafter), under its Organic Law, as amended, is authorized to construct and maintain public works for flood control, manage navigation in Commonwealth waters, to conserve and protect the natural resources of Puerto Rico, to study and manage coastal resources, and to wisely administer marine, aquatic and terrestrial resources for the public good. The Secretary of Natural Resources is a voting member of the San Juan Bay Estuary Program. DNER jointly administers the Puerto Rico Coastal Management Program with the Puerto Rico Planning Board. It is within the authorities and powers of DNER to apply for permits and to conduct environmental improvement and flood control projects.

1.2 PROJECT LOCATION.

Caño Martín Peña is located in San Juan, Puerto Rico, about 2 miles south of the Atlantic coast, south of Santurce ward of the city. It is a narrow, 3.75 mile long, winding water body that connects Laguna San Jose, on the east, to San Juan Bay, on the west. Its waters are brackish to saline, and it is tidally influenced. It divides the Santurce and Hato Rey wards of San Juan. The study and proposed project run from the west side of the Muñoz Rivera Avenue bridge to Laguna San José. (see Main Report Plate 1, vicinity map and plan view). CMP drains about 2,500 acres.

The immediate banks of the Channel are flat but lands north of the channel rise to elevations of slightly more than +50 feet less than ½ mile away for most of its length. Residential areas along the north bank between Barbosa Avenue and Ponce de Leon Avenue flood frequently. CMP north and south banks were previously cleared, during "model city" programs of the 1960's and 1970's, between the Kennedy Ave bridge and the Barbosa Avenue bridge. Neighborhoods adjacent to the channel in the project area are, on the north bank, starting at the western end: Marina, Barrio Obrero, Buena Vista (Santurce), and Cantera. Along the south bank, from west to east, they are: Parada 27, Las Monjas, Buena Vista Hato Rey, Bitumul, Israel, and Sierra Maestra.

1.3 PROJECT NEED.

Over the past 50 years, as adjacent neighborhoods were filled for housing, CMP has become encroached upon by intentional fill, debris disposal and sedimentation from urban runoff. East of the Barbosa Avenue bridge, housing has encroached into the channel itself, particularly along the south bank. At present CMP is nearly completely obstructed by an accumulation of sediment, unauthorized fill, and domestic refuse. Its measured depth is only inches in some spots, to a maximum depth of 3 feet. Urban runoff, accidental sewer overflow and discharges from sewer bypasses reach the channel, adding nutrients and bacteria to its waters. Because of the small cross-sectional area of open water, there is insufficient water to dilute wastes reaching the channel, and great resistance to tidal flushing. Net water flow due to winds and tides is east-to-west, but in its present state of blockage and sedimentation this net flow is nearly zero.

The San Juan Bay Estuary Program, a joint Commonwealth Federal program under the National Estuary Program of the US Environmental Protection Agency, provided the planning impetus for a comprehensive study of pollution problems in the Bay and lagoons around San Juan. Hydrodynamic and water quality models (simulation models) were developed for the Program by the US Army Waterways Engineering Station (WES). Outputs from model simulation runs indicated that CMP is a major source of pollutants to the Bay-estuary system, and at the same time, a choke point in the natural circulation. This information, in addition to observations of water quality improvements in western CMP after the 1987 dredging for the "Agua-Guagua" (now Acua-Expreso) Project, led DNER to request design and planning assistance from USACE to develop alternatives for dredging the eastern half of the channel. The project discussed in this document was formulated in close coordination with DNER, SJBEP, other Commonwealth agencies, the Municipality of San Juan, and members of the government-private Cantera Project. The Design Report and this D-EIS are intended to be used as a government planning document, and eventually, would accompany a Permit Application to the Corps of Engineers and other Federal regulatory agencies. At such time as the permit application is submitted to the Corps, this document would become a Federal D-EIS, and the Federal action would be issuance of permits to allow the dredging to proceed.

1.4 AGENCY GOAL

The Proponent of the project, and Applicant for the Federal Permit, is DNER. DNER's goals are set forth in letters and a Memorandum of Agreement between DNER and USACE. As expressed in DNER's August 1, 1996 letter, the main purpose of the study and design effort was to provide water quality improvement in the Channel and adjacent water bodies. Secondary purposes included aquatic transportation and urban redevelopment. DNER requested that the design be consistent with the existing "Acua-Expreso" project, and also requested initially that no bridge replacement be considered as part of the channel design. The design was also intended to be consistent with other approved land use plans for the affected area, particularly the Cantera Peninsula. A second letter, dated August 30, 1996, reiterated the three design objectives as: (a) improvement of water quality in the San Juan Bay Estuary System; (b) contribution to the integrated development of Cantera Peninsula; and (c) improvement to CMP navigability.

1.5 RELATED ENVIRONMENTAL DOCUMENTS.

In 1983, the Puerto Rico Department of Public Works, the Federal Urban Mass Transportation Administration (UMTA) and USACE published an Environmental Impact Statement for the water transportation project called "Agua-Guagua." This navigation project included dredging the western half of CMP to a width of 200 feet and a depth of 10 feet. Dredging was performed by USACE. Biological field work for this project (O. Díaz et. al., 1983) was done in 1982, and reported as an Appendix to the 1983 EIS. The Appendix's general description of aquatic organisms and mangrove fringe birds is still generally applicable. This document noted that fishes became scarcer as the sampling effort moved eastward, and that virtually no fishes appeared to inhabit the Channel east of the Tres Monjitas tributary channel. The "Agua-Guagua" EIS is the only known environmental document prepared under the National Environmental Policy Act (NEPA) that discusses dredging this water body. There have been numerous other studies, however, by Federal and Commonwealth agencies, of CMP water quality (Ellis & Gómez-Gómez 1975, EQB 1989; Kennedy 1996; Webb & Gómez-Gómez, 1998). Planning studies done for the local government have discussed improving water circulation in CMP since at least 1970. The most recent such planning document is the SJBEP Comprehensive Conservation and Management Plan , finalized in 1999.

1.6 DECISION TO BE MADE.

This Environmental Impact Statement will evaluate whether to dredge Caño Martín Peña's eastern end and, if so, evaluate alternatives to accomplish that goal.

1.7 SCOPING AND ISSUES TO BE EVALUATED IN DETAIL

Preliminary scoping was accomplished by letters directed to Commonwealth and Federal agencies and participants in the citizens' groups involved in the Cantera Peninsula Restoration. The following issues were identified during scoping and by the preparers of this Environmental Impact Statement as relevant to the proposed action and appropriate for detailed evaluation: impacts on residents (disruption of daily activities, relocations), water quality improvement, quantity of dredged material, dredging costs, disposal costs, impacts on wetlands (quantity, quality), flood mitigation potential, navigation potential , project maintenance requirements, bridges affected and utilities affected.

1.8 IMPACT MEASUREMENT

The following provides the means and rationale for measurement and comparison of impacts of the proposed action and alternatives:

Residential impacts were measured by the most probable number of relocations of residential structures (homes) under each plan.

Impacts on infrastructure were measured by the cost of replacing or restoring interrupted elements, such as bridges/roads, electric lines, cable, water and sewer lines. Cost was estimated in present dollars.

Water quality improvement was based on results of simulations using the WES hydrodynamic and water quality models of San Juan Bay Estuary System, using the parameters selected in the WES model, which include salinity concentration, coliform bacteria, dissolved oxygen, and dissolved nutrients (N, P).

Dredged material quantities were estimated in cubic yards.

Dredging cost estimates were based on quantities and costs for similar projects (using Corps cost estimating software)

Disposal costs were based on cost-estimating software, as above, and reasonable costs for similar projects, based on information developed by cost engineers at the Corps Jacksonville District office.

Impacts on wetlands were estimated by acreage gained or lost and function. Acreage was measured directly using Microstation design software. Functional gains or losses were estimated using the "E-WRAP" method for estuarine wetlands. This analysis was developed in Florida and has been applied to tropical Florida ecosystems including mangroves, salt marshes and freshwater marshes. Adverse effects of disposal were investigated for all disposal methods considered.

Flood mitigation potential of all three action alternatives was compared qualitatively. Project maintenance requirements were compared qualitatively. Effects on bridges were: either a particular bridge could be saved, or its removal was required, depending on clearance between the water surface and the bridge deck above (to provide access for the barge carrying dredged material), and, more importantly, clearance between the water surface and the top of the pile caps supporting the bridge. The affected section of CMP is underlain by very soft peaty material, and bridges are supported on driven piles. If the top of these piles is near the water surface, then either the bridge cannot be saved, or, if it is, the channel cross-section under that bridge will be so much smaller than the desired channel cross-section that no overall water circulation benefits can be derived from dredging.

Effects to historic properties were measured against the criteria of effect and adverse effect established in 36 CFR Part 800.

1.9 ISSUES ELIMINATED FROM DETAILED ANALYSIS.

The following issues were not considered important or relevant to the proposed action based on scoping and the professional judgment of the preparers of this Draft EIS: Impact on rare, threatened or endangered species or species of special concern (none were identified in the project area); impacts on designated Coastal Barriers (none in the project area); impacts on agriculture or farmlands.

1.10 PERMITS, LICENSES AND ENTITLEMENTS

Dredging and sheet pile wall construction in the waterway, as well as in-water disposal of the dredged material, will require a permit from the USACE under Section 10 of the 1899 Rivers and Harbors Act and Section 404 of the 1972 Clean

Water Act. The work will also require authorization from the Commonwealth of Puerto Rico's Environmental Quality Board (a Water Quality Certificate). The project will require determination, by the owner, of consistency with the Puerto Rico Coastal Management Program, followed by concurrence of the Puerto Rico Planning Board with this Determination.

2 ALTERNATIVES ANALYSIS

This section describes in detail the no-action alternative, the preferred (recommended) action, and other reasonable alternatives that were studied in detail. This section presents the beneficial and adverse environmental effects of all alternatives in comparative form, providing a basis for choice among the options for the decision maker and the public.

2.1 DESCRIPTION OF ALTERNATIVES.

DREDGING ALTERNATIVE 1: TRAPEZOIDAL, 10 FOOT DEEP CHANNEL.

Under this alternative, a trapezoidal channel would be dredged; it would be 10 feet deep by 11,600 feet long. This alternative would require removal of the Barbosa and Muñoz Rivera Avenue bridges to allow excavation to –10 feet, and a 20 foot overhead clearance for the mechanical dredge to work from the water. A total of 550,000 cubic yards of excavated material would be generated. This Alternative is shown on Main Report Figure 5, as well as Alternatives 2 and 3,. The channel would have earthen, sloping walls with side slopes set at 1 (vertical) on 5 (horizontal). Channel top width would be 150 feet along straight sections and minor bends, and up to 230 feet at major bends. Bottom width would be between 20 and 95 feet. Under this option, two bridges and the Rexach Avenue sewer siphon would need to be replaced. Minimum channel cross-section through the straight sections would be 850 square feet.

DREDGING ALTERNATIVE 2: RECTANGULAR, 10 FOOT DEEP CHANNEL.

This dredging alternative is a vertically-cut, rectangular channel, 11,600 feet long, with a depth of 10 feet. It would be 150 feet wide along straight and minor bend sections, and 230 feet wide at major bends. Channel side walls would be supported by corrosion-resistant steel sheet pile bulkheads with a concrete pile cap The new bulkhead would be gapped every 50 feet, except on the north side between stations 62+00 and 87+00. Each gap would be 8 feet wide and 2.83 feet high with a bottom elevation of 0.0' (mean low water, MLW) and a top elevation of + 2.83.' The ground behind the bulkhead would be degraded to elevation EL. 0.0 for 10 to 25 feet horizontally and then transition to existing grade using a 1 on 3 slope. Mangroves would be planted behind the bulkhead. Minimum channel cross-section, under this option, would be 1,500 square feet. As is the case with

Alternative 1, all three bridges and the Rexach Avenue sewer siphon would be replaced.

DREDGING ALTERNATIVE 3: TRAPEZOIDAL, 'MINIMAL' CHANNEL.

This alternative would involve clean up and removal of part of the debris plug from CMP. The channel cross section would be trapezoidal, and the clean-out would cover 11,200 lineal feet. Top width of the channel would be limited to 200 feet at the bridges, and maximum depth would be constrained by the pile caps of the Barbosa Avenue bridge (-3.5 feet, approximately). Channel construction would be by means of a long boom crane, from an access road cleared on both north and south banks of the channel. Since the uppermost layer of material in the channel appears to be very soft, side slopes of the cut would have to be 1 (vertical) on 10 (horizontal). This side slope would allow a channel width of about 70 feet, much less than the "historic" channel width. This alternative would not require bridge removal, and would impact only about 180 structures, but it would not provide a very effective or lasting improvement in flushing of the system. It would generate an estimated 25,000 cubic yards of material for disposal.

DISPOSAL ALTERNATIVE 1: EXISTING LANDFILL DISPOSAL

This Alternative was examined in the early stages of planning. All land disposal alternatives would require double handling of material, because the material would initially be saturated with water. Drying would require identification of a large staging area in which the material could be dried, and a disposal site. It was assumed that, since some of the material plugging the channel was known to be construction debris and trash, landfill disposal might be an option. However, none of the existing landfills in the area has reserve capacity enough to accept the volume of material that would be generated by either Dredging Alternative 1 or Alternative 2. In the case of the Recommended Alternative, which would generate about 750,000 cubic yards of material, this would require about 50,000 large truckloads for transport to a landfill.

Use of existing landfills is feasible only for Alternative 3. It was not investigated further when no nearby landfill with adequate capacity for the other Alternatives was identified.

DISPOSAL ALTERNATIVE 2: CREATE LANDFILL FOR DISPOSAL

This alternative was considered during early formulation, when no method for in-lagoon disposal had been worked out. It would require acquisition, designation and preparation of up to 30 acres of land, located within 5 miles of CMP. A site, located in the Municipality of Carolina, adjacent to Roberto Clemente Sports City, was identified (See Main Report Figure 7 and Plate 2). Upon more detailed examination the site proved to be largely jurisdictional wetland. Plant cover is dominated by a mix of sedges and grasses, with a few flood-tolerant trees such as

Australian pine and Melaleuca. Under this alternative, the excavated material would be transported across Laguna San José on barges, unloaded at a dock on the eastern side of the Lagoon, stockpiled near the dock, and later transported to the landfill. The landfill would require the following preparation to avoid leaching of potentially toxic materials: a ring levee, 20 feet high, 130 feet wide at the bottom and 10 feet wide at the top, would encircle the disposal site. The landfill would require an impervious liner and cover of High Density Polyethylene (HDPE), systems for collecting and treating leachate and stormwater, gas vents, and a clay cover. The cost of such a facility was estimated, for comparison with other disposal alternatives, at over $60 million. No undeveloped upland sites of sufficient size were found anywhere within a reasonable trucking distance of the dredge site. The site identified is wetland; therefore, mitigation for conversion of 30 acres of emergent wetland would also be required.

DISPOSAL ALTERNATIVE 3: DISPOSAL IN SAN JOSÉ LAGOON HOLES

This alternative involves barging excavated material to San Jose Lagoon and disposing of it to fill two or more deep holes, one in the southeastern corner of San José and one inside the cove called "Los Corozos" in the northwestern corner of San José. It is illustrated on Main Report Fig 7 and Plates 1 and 2. Disposal area No. 1, in Los Corozos, has capacity for 80,000 cubic yards of material and would be filled first. Disposal Area No. 2, in southeastern San Jose, would have capacity for 630,000 cubic yards, in its deepest hole, and an adjacent hole would hold any remaining material. Each hole would be circled, in turn, with a turbidity curtain extending to the bottom. The excavated material would be deposited to fill the hole to –10 feet. A cap of select material would then be deposited to create a 5 foot thick cap over the excavated material and bring the top of the disposal area up to the rest of the lagoon floor, at -5 feet.

It is estimated that up to 5 percent of the excavated material would consist of floating materials and debris not suitable for in-bay disposal. This material would be separated on a vacant upland staging area, shown on Plate 2, then trucked to designated, authorized landfills.

NO ACTION (STATUS QUO) ALTERNATIVE

Under this alternative no dredging would be done in eastern CMP. The no-action alternative assumes all other programs and projects currently underway, permitted and/or planned for the short-term future, would continue. Under this alternative little improvement in overall water quality can be expected, even if currently unsewered neighborhoods are provided sanitary sewers, and other urban renewal projects not tied to dredging the Channel, such as parts of the Cantera Project, go forward. Ongoing sedimentation of the channel from urban runoff is expected to continue. The eastern part of CMP will eventually fill in and disappear. The adverse public health and aesthetic effects of living next to a choked, anaerobic and foul-smelling channel will continue into the near future, and lack of an outlet for upland runoff might induce further shallow flooding from ponding of local drainage.

2.2 BASIS FOR ALTERNATIVE SELECTION

The selection of the recommended alternative was based on engineering considerations, cost comparisons, effectiveness in achieving the project goal, adverse effects and their potential for mitigation, completeness, ease of maintenance, provisions for future navigation, and compatibility with Puerto Rico and Federal policy and programs.

2.3 ALTERNATIVES ELIMINATED

All dredging alternatives considered in the USACE study have been listed above. An initial disposal alternative was ocean disposal at the approved San Juan Offshore Site. However, materials proposed for dredging were tested for eligibility and did not pass. Only "dredged materials", i.e., marine substrates, are eligible for offshore disposal. A considerable fraction of the materials to be excavated are "fill" or domestic and construction debris. These materials are not eligible for ocean disposal. Furthermore, the natural substrate is so intermixed with the fill and debris that no practical way of separating the components could be developed.

2.4 COMPARISON OF ALTERNATIVES

Table 1 lists dredging alternatives considered and summarizes the major features and consequences of the proposed action and alternatives. Table 2 lists disposal alternatives considered and their consequences See section 4.0, "Environmental Effects" for a more detailed discussion of the environmental effects of the recommended alternative..

2.5 RECOMMENDED ALTERNATIVE

Alternative 2 (Vertical channel alternative) with Disposal Alternative 3 (disposal in deep holes in Los Corozos and San José Lagoons) is the alternative recommended by the Corps and preferred at this time by the local project proponent. This alternative maximizes channel cross-section, providing maximum initial flushing of the whole Lagoon-Channel-Bay system. It avoids removing the historically significant Ponce de Leon Avenue bridge by providing additional channel width at this point to compensate for a slightly shallower depth. The large channel cross-section provides some incidental flood retention capacity for adjoining lands and provides for small boat navigation access to the improved channel. The recommended disposal option minimizes double-handling of materials, does not require further wetland loss, and is expected to contribute to improving water quality and circulation in San José Lagoon.

2.6 WETLANDS MITIGATION

Mitigation for loss of mangrove wetlands, by creation of new mangrove stands on-site, is proposed. Eight acres of mangroves fall under the channel "footprint" of either Alternative 1 or Alternative 2. There are 9 acres available for mangrove creation under Alternative 2, the preferred alternative. Using a "desktop" application of the "E-WRAP" method for functional evaluation of estuarine wetlands, it appears that this mitigation should replace lost mangrove wetland functions and values.

Table 1: Summary of Dredging impacts

ALTERNATIVE ENVIRONMENTAL FACTOR	Alternative1. 10 Foot Deep Channel with sloping sides	Alternative2. 10 Foot Deep Vertical Sided Channel	Alternative 3. "Minimal" 3.5 Foot deep, Trapezoidal Channel	No Action Status Quo
IMPACT ON RESIDENTS: RELOCATIONS	438	438	180	None
WATER QUALITY IMPROVEMENT AND PUBLIC HEALTH	Substantial: 1500 square foot minimum cross-section area	Considerable: 650 square foot minimum cross-section area	Very little: 123 square foot minimum cross section area	None
QUANTITY OF MATERIAL GENERATED (FOR DISPOSAL OFF-SITE)	550,000 cubic yd	750,000 cubic yards	25,000 cubic yards, mostly debris	None
DREDGING/DISPOSAL COST	~ $73,000,000	~$110,000,000	~$27,000,000	None
IMPACT ON MANGROVE WETLANDS	8 acres	8 acres	3 acres,	None
IMPACT ON HISTORIC PROPERTIES	None	None	None	None
FLOOD MITIGATION POTENTIAL	Moderate improvement	Moderate improvement	Very slight improvement	No improvement
PROJECT MAINTENANCE REQUIREMENTS	Significant	Moderate	Substantial: will sediment in very quickly	None

ALTERNATIVE ENVIRONMENTAL FACTOR	Alternative1. 10 Foot Deep Channel with sloping sides	Alternative2. 10 Foot Deep Vertical Sided Channel	Alternative 3. "Minimal" 3.5 Foot deep, Trapezoidal Channel	No Action Status Quo
NAVIGATION	Small craft only (runabouts, oar-powered craft and small fishing boats)	Very good: some specialiazed types of ferries designed for restricted clearance could navigate, in additiona to small fishing, pleasure craft	None: as at present, insufficient clearance above bottom.	None
BRIDGES REMOVED (COST)	Muñoz Rivera Ave. and Barbosa Ave.	Muñoz Rivera Ave. And Barbosa Ave.	None	None
ESSENTIAL FISH HABITAT	Improvement of migratory route, estuarine fish, juvenile fish habitat	Very marked improvement in fish habitat	Slight or no measurable improvement in fish habitat.	None

Table 2: Summary of Disposal Impacts. Where three alternative quantities are given, they correspond to the rectangular channel, trapezoidal channel and minimal channel dredging alternatives, respectively.

ALTERNATIVE ENVIRONMENTAL FACTOR	Alternative1 Use an Existing Landfill.	Alternative2 New landfill	Alternative 3: In-bay disposal in San Jose and Los Corozos Lagoons	No Action Status Quo
Wetlands Impacted	N/A	30 Acres Emergent	None; disposal would be in deep bottom under open water, and material would be capped imperviously	None
Truckloads of material to cart to landfill	50,000 Rectangular channel 35,000 Trapezoidal channel 2,000 'Minimal' channel	Barging, rather than trucking, quantities same as column to the left, depending on size of channel..	Under "maximum" alternative, 5% of total, or 2,500 truckloads, of floatables, would have to be landfilled.	None
Acreage of lands required	None; existing landfills would be used.	Minimum 30 acres under recommended plan (Dredge Alternative 2)	Staging areas, total of 11.5 acres uplands.	None
Maintenance requirements	None (covered by Municipal or Regional tipping fees)	Landfill would require constant monitoring, repair over life of project (50 years)	Monitoring of superficial sediments and water column over disposal sites required to determine that areas are effectively capped and isolated.	None
Tipping fees required	$100.00 per ton average; $2,000 per truckload average	None	None	None
Ultimate capacity	No capacity for any but the "minimal" alternative (Dredge Alternative 3)	Capacity for "maximum" Dredge Alternative (Alternative 2) over life of project (50 years)	Additional holes in Laguna San Jose provide capacity for this and other dredging projects for many years.	None

3 AFFECTED ENVIRONMENT

3.1 GEOGRAPHIC AND HYDROLOGIC SETTING

Caño Martín Peña runs between Laguna San José, on the east, and the southeastern corner of San Juan Bay, on the west. Originally, Quebrada Juan Méndez emptied into its eastern end, as well (refer to Figure 3, Main Report). The channel is the line of demarcation between the San Juan wards called Santurce (on the north) and Hato Rey (on the south). Individual neighborhoods adjoining the channel are called, on the south side, beginning at Avenida Luís Muñoz Rivera and moving eastward, Parada 27, Las Monjas, Buena Vista (Hato Rey), Bitumul, Israel, and Sierra Maestra. On the north side of the channel, also from west to east, are the neighborhoods Marina, Barrio Obrero, Buena Vista (Santurce), and Cantera. The first bridge over the channel was built in 1784, over a ford in the location now occupied by the Ponce de León Avenue bridge. The channel was apparently of variable width and rather shallow. It was described in 1900 as 30 to 150 feet wide and 2 to 10 feet deep, with the banks covered by low mangrove bushes. and oysters growing on the tree roots (Evermann 1900). The earliest detailed aerial photography of San Juan, dating from 1936, is reproduced as Figure 3 in the Main Report. The photo shows only marshes and shrubs bordering the channel on the south, while small shacks, evidently accessed via unpaved roads or boardwalks, extend nearly to the channel on the northwest, in Barrio Obrero. In 1946 the channel was much wider than reported in historic documents, ranging from 200 to 400 feet, and it must have been used for navigation. Interestingly, this photo does not show tall mangroves lining the channel. It appears that at the time, the bushes were kept constantly pruned for firewood, or regularly cut for charcoal.

By the 1950's urban expansion had filled in the wetlands on both sides of the channel. The topographic quadrangle map of 1949 shows the area as completely urbanized. By the early 1960's the channel was densely lined with "stilt houses" in many areas. These wooden dwellings generally had no sewer connections, and sanitation was often achieved through a hole in the floor. Beginning in the late 1960's, under the Federal "Model Cities" program, the Municipal government removed most of these substandard dwellings. The residents were relocated to public housing elsewhere in San Juan, but the canal was not dredged. A strip of land was cleared on each side of the channel between Ponce de Leon and Barbosa Avenues, and it was maintained for a time as a linear park, after the housing and docks were demolished and fill was brought in to stabilize the banks. Since the mid-1970's, however, some parts of the "park" or maintenance right-of-way have been invaded by outbuildings, fences, garages and other structures. East of the Barbosa Avenue bridge, on the south bank of the channel where the

"Model Cities" program did not reach, a whole neighborhood still extends well inside the bed of the former channel.

The channel receives local runoff from the eastern hill of Santurce, as well as from the relatively flatter area of central Hato Rey. Some of the existing neighborhoods, especially east of Barbosa Avenue, are still not sewered. Due to the dense grid of streets, tightly packed residential and commercial areas, and some industrial activities centered around Ponce de Leon and Barbosa Avenues, runoff is urban and brings oil and grease, bacteria from animal and human waste, metals and other "conventional" contaminants into the channel

3.2 WETLANDS AND VEGETATION

Plant cover is sparse in the densely packed neighborhoods lining the channel, except in park spaces and a few public use areas. Trees are largely ornamental exotics, including cassia, African tulip, poinciana, mahogany, albizia, and a few others. There is a thin line of mangroves lining CMP on both sides. Except where mangrove seedlings have become established over sediment banks on the edges of the channel bed, the trees form a single line, growing at the base of the berm created when the old channel-side shacks were demolished in the 1970's. These mangroves contain a mixture of all three true mangrove species. Near the Muñoz Rivera and Ponce de León Ave bridges, red mangroves predominate. Along the narrowest, sharp curves of the middle reach, black and white mangroves are more common. Where the channel opens out into Laguna San José red mangroves again are the dominant species. The mangroves provide a screen between the urban areas and the water as well as habitat for wading and perching birds, mangrove crabs and introduced green iguanas. Under the no-action alternative, plant cover will continue to become more and more scarce, and structures will continue to invade the right of way of the channel.

3.3 THREATENED AND ENDANGERED SPECIES

No endangered or threatened species have been identified in this segment of Caño Martín Peña by any fish or wildlife agency consulted. Brown Pelicans, still considered endangered in Puerto Rico, may occasionally be observed resting on taller mangrove trees nearly anywhere in San Juan, including mangroves lining western San José Lagoon, but they seldom alight in the channel, for the water is too opaque and anaerobic to support fish or a sight fishery. Under the no-action alternative the limited perching habitat now available for brown pelicans would be expected to decrease as the channel continued to sediment in.

3.4 FISH AND WILDLIFE RESOURCES

There is very limited wildlife habitat in the area around CMP. Urban "wildlife" consists of nuisance exotic species (rats, mice, feral cats and dogs, green iguanas) resident and migratory birds, and bats. The commonest birds heard in the mangrove fringe are bananaquits, but grackles, yellow warblers and shiny cowbirds are also heard and seen in the area. Winter migrants using the fringe include water thrushes and several species of migratory warblers. Fish resources of the channel are limited (O. Díaz et. al. 1983). Practically the only fish occasionally found in or near the eastern channel are introduced tilapias, and, occasionally, mullet. Fish resources, when observed in the eastern channel, appear to be highly stressed, and fish kills are common.

3.5 ESSENTIAL FISH HABITAT

Essential Fish Habitat is habitat for Federally regulated species of marine and estuarine fish, as designated by regional Fisheries Management Councils under the Magnuson-Stevens Fishery Conservation and Management Act. Formally speaking, all saltwater and estuarine habitats in Puerto Rico and surrounding waters are designated Essential Fish Habitat. However, due to the poor quality of "conventional" water quality parameters in eastern CMP, the channel's value as any kind of fish habitat is extremely limited at present. Dissolved oxygen values generally hover at or near zero in the central channel, water transparency is low, and forage organisms are apparently absent. Under the no--action alternative, as the channel continues to fill in, communication between the habitat of San José Lagoon and San Juan Bay will be completely eliminated. Eventually, the channel bottom will be raised above tide level, and at some point the entire area may become filled in. The Corps has made a preliminary determination that the quality of the EFH would improve under any dredging alternative other than the "status quo" or no-action alternative. This determination will be coordinated with the National Marine Fisheries Service prior to Federal action on the permits.

3.6 WATER QUALITY

Water quality in the San Juan Bay Estuary has recently been summarized by Webb and Gómez-Gómez (1998). Net flow in the channel (measured 25 years ago, when there was still perceptible flow) is to the west. No matter which "conventional" contaminant is measured, CMP stations consistently showed the poorest water quality among all the sampling stations examined in this study. Nitrogen and phosphorus concentrations are consistently high, Turbidity is high, as are indicator bacteria counts, and dissolved oxygen is low. Poor water quality is due to impeded flushing, surface water input from unsewered neighborhoods, storm runoff, and some illegal direct sewage discharges.

3.7 HAZARDOUS, TOXIC OR RADIOACTIVE WASTE

The firm Roy F. Weston Inc. completed a site characterization study of Caño Martín Peña on August 1997, including chemical analysis and geotechnical testing, of sediment and water samples from canal, canal side and lagoon locations. Subsequent testing of soil and water samples from test pits within the excavation area was done by ECG, Inc., in June 1998. Soils in the area showed elevated total lead and mercury concentrations. Tests revealed similarities in chemical and textural composition of the uppermost sediments of the entire test area. Elevated total lead and mercury concentrations, as well as lesser concentrations of other compounds, were detected in the samples. Elevated levels of mercury and lead are fairly common in sediments deposited in/near urban environments. Lead levels are still high, though they have decreased over the past decade, in San Juan Bay sediments. They are thought to have originated from automobile exhaust emissions during the period when lead was a common additive in gasoline. Elevated mercury levels are thought to be partly a reflection of fossil-fuel generated exhaust emissions (exhaust particles from both vehicles and fossil-fuel burning electric generating plants), and partly derived from the weathering of Puerto Rico's upland rocks.

3.8 AIR QUALITY

The airshed of the eastern channel is in compliance with primary air quality standards, according to the Puerto Rico Environmental Quality Board.

3.9 NOISE

The immediate environment is moderately noisy. Residences are spaced closely, and traffic on nearby roads includes heavy tractor-trailers, city buses and many commercial trucks. Ponce de León, Muñoz Rivera and Barbosa Avenues are major arteries into Santurce and Hato Rey, and they carry commercial traffic 24 hours a day. Since the area is already densely built out, no significant noise increase is considered likely.

3.10 AESTHETIC RESOURCES

Aesthetic resources are defined as "those natural and cultural features of the environment that elicit a pleasurable response" in the observer, most notably from the predominantly visual sense. Consequently, "aesthetic resources are commonly referred to as visual resources,...features which can potentially be seen." Most neighborhoods adjoining the channel are residential. Houses tend to be single or two story dwellings, built on small, narrow land lots. Narrow streets and tight spaces between houses often limit views of the channel to the first house adjacent. Most residents do not appear to consider the channel an amenity or visual resource, as indicated by house orientation (generally, with a side or back to Martín Peña), In many areas, channel-side easements have been obstructed with discarded trash, abandoned vehicles or outbuildings. Even the few small parks located near or on the channel do not utilize or reference the mangrove fringe or the waters. The current appearance (dark grey to black and opaque) and disagreeable smell of the waters does nothing to make the channel attractive. Under the "minimal" or the no-action alternatives, visual aesthetics of the project area would not improve significantly.

3.11 RECREATION RESOURCES

Existing recreation opportunities are limited to several basketball courts and a few solitary backboards, as well as three fairly new and small playgrounds. There are no designated parking facilities along the canal. There are no access points for fishing (probably not a major issue at present, since fish are rare or nonexistent in the central canal's stagnant waters). There are no sites or elevated points for wildlife observation, with the exception of sidewalks on the three existing bridges. There are opportunities to provide new access points within the design constraints of the channel improvements, and USACE was requested to incorporate a recreation trail and access points into its design. Unless the water quality of the channel can be improved, there is little likelihood of any further recreational development along its banks, however.

3.12 NAVIGATION

At present CMP is navigable by small boats (equipped with outboard motors with a foot that can be raised) only with great difficulty, due to the large quantity of semi-floating, semi-submerged debris in the channel and extensive shoals formed by sediment. It is navigable, with difficulty, by paddle powered craft, but elevated bacterial counts in its waters make it unsuitable for skin contact.

3.13 CULTURAL RESOURCES

Three bridges, carrying Avenida Luis Muñoz Rivera, Avenida Ponce De Leó́n, and Avenida Barbosa over CMP, are located within the project's area of potential effect. The Muñoz Rivera Avenue bridge is of recent construction and is not eligible for the National Register of Historic Places. The Barbosa Avenue bridge was built in 1931 but has been extensively modified and is also not eligible for the National Register. The Ponce de León bridge is eligible for inclusion on the National Register. In a letter dated December 10, 1997, the Puerto Rico State Historic Preservation Officer (SHPO) gave the opinion that the bridge may be eligible under all four eligibility criteria established in 36 CFR Part 60. The 438 residential structures were built after 1950, as established from aerial photographs, and are not significant. The dredging will effect only sediments deposited after approximately 1950, therefore no significant archeological deposits are within the area of potential effect.

4 ENVIRONMENTAL EFFECTS

The reader is also referred to Tables 1 and 2 in section 2.0 ("Alternatives"), for a summary of impacts. The following includes anticipated changes to the existing environment including direct, indirect, and cumulative effects.

4.1 CONSTRUCTION EFFECTS

These effects will occur only while the project is under construction. Dredging will generate some additional noise in residential areas adjacent to the channel. Daytime dredging only (not 24-hour operation) is recommended. Bridge removal (Barbosa Avenue Bridge and Luis Muñoz Rivera Bridge), required under the recommended alternative, would have to be accomplished prior to dredging all but the easternmost segment of the channel. Unless bridge removal is scheduled sequentially, some serious traffic congestion could potentially occur. During dredging and disposal (under Disposal Alternative 3), some additional suspended organic matter and fine sediments will cloud the channel's waters. The lagoon disposal areas would be protected by a turbidity curtain surrounding the disposal site, under this alternative, and most of the fine particulate materials suspended during deposit of the dredged material should be confined to the immediate site. The material deposited in the holes in Laguna San Jose and Los Corozos would be capped with select material to isolate it from the overlying waters. All of these effects will be transitory and are not expected to last beyond the actual dredging. Bridge replacement, when finished, will ease traffic congestion, especially at the Barbosa Avenue bridge. Dredging for this project may last from 18 months to 2 years.

4.2 WETLANDS AND VEGETATION

No significant native vegetation, other than the mangroves lining the channel, will be impacted under the recommended dredging alternative, unless the "create landfill" disposal alternative is selected. This alternative involves creating a landfill over 30 acres of emergent wetlands, and would require development of a mitigation plan, probably for enhancement of adjacent wetlands at the proposed disposal site. Only a few small shade trees are present along CMP on the bank side of the right-of-way. These trees belong to common ornamental species and can easily be replaced by nursery stock. A Commonwealth tree ordinance requires replacement of ornamental trees removed for public works projects, but this is not a Federal requirement.

The mangrove wetlands would be equally impacted under Alternatives 1 or 2. The "footprint" of the channel over mangroves would be 8 acres (the top width of these two alternative designs is the same). The "minimal channel" (Alternative 3) would require removal of only 3-4 acres (at the narrowest point of the channel). These mangroves are functionally limited to wildlife (bird) habitat. Poor current channel flow limits other normal mangrove functions, such as export of production to the coastal waters and fish-nursery functions. They are used, as are the exotic ornamental trees, for perching, resting and nesting by human adapted birds such as bananaquits, doves, thrashers and others. Restored mangrove areas, adjacent to the improved channel, should provide enhanced habitat and productivity functions.

4.3 THREATENED AND ENDANGERED SPECIES

No designated species or habitats would be affected under any action alternative.

4.4 FISH AND WILDLIFE RESOURCES

Dredging Alternatives 1 and 2 would generate considerable improvements in fish habitat, according to the WES model output, as waters of CMP would become better oxygenated and more hospitable to life. As a secondary effect, water quality in San José Lagoon and San Juan Bay is expected to improve as well. The degree of overall fish habitat improvement is expected to be directly related to the volume of water moving through the channel. Under the "minimal" dredging alternative, no significant or lasting improvements in fish habitat can be expected. Given the fact that the surrounding environment is totally urban, the only wildlife habitat considered is that now offered by the mangroves lining the channel. Under either Alternative 1 or 2, this perching habitat will temporarily be partially removed, to be replaced as the channel is built. Replacement of the mangroves inside the channel will be acre-for-acre, as this area does not provide especially high quality habitat at present. Under the related recreational plan, a linear park would be built either over the maintenance right-of-way (next to the channel) in Alternative 1, or over and adjacent to the concrete pile caps (in Alternative 2). This area would be developed as a "green space" with additional trees and shrubs planted. Adding the linear park will increase wildlife habitat, but will continue to favor mainly common, tolerant bird species.

4.5 ESSENTIAL FISH HABITAT

Although the channel is formally essential fish habitat (EFH) at present, dissolved oxygen is so low, sulfide levels are so high, and forage for juvenile fish is so poor, that it is essentially barren. Furthermore, it is exporting contamination to the "downstream" area of inner San Juan Bay, thus negatively affecting water quality over a much wider area, according to model outputs from the USACE water quality model. All three dredge action alternatives should provide improvements to EFH elsewhere in the Bay-Lagoon system. Improvements should be greatest under Alternative 2, slightly less under Alternative 1 and minimal under Alternative 3.

4.6 WATER QUALITY IMPACTS

Most effects of the dredging and disposal of the debris and sediment plug in CMP are expected to be positive. According to the results of the hydrodynamic and water quality modeling, increased circulation should lead to improved dissolved oxygen concentration, a lower concentration of nutrients and pollutants in the inner channel, and higher salinities, favoring re-establishment of marine and estuarine fish. Negative effects, expected to be of short duration, will be related to disturbance of anaerobic bottom sediments during the dredging itself. Due to the low current velocities in the area to be dredged, no turbidity plume is likely to be detectable.

4.7 HAZARDOUS, TOXIC AND RADIOACTIVE WASTE

No likely sources of this material were found during soil, water and sediment sampling for this study, in spite of the numerous samples that were analyzed. No adverse effects are expected as a result of the proposed project.

4.8 AIR QUALITY

No adverse effects on particulate material, ozone or other regulated emissions are expected to occur due to the proposed action. Dredging will be a relatively low-technology operation. Vehicle and dredge emissions would be negligible, in relation to the hundreds of thousands of vehicles currently operating in this air shed every day.

4.9 NOISE

Additional noise would be generated during the dredging and disposal phase of the project. However, due to the existence of a non-residential buffer strip along both sides of the channel, local noise limits for residential areas would not be violated at the nearest property boundary. Disposal activities would occur in a non-residential area and would not generate nuisance noise levels. Dredging in residential areas is recommended only during daylight hours.

4.10 AESTHETICS

The visual quality of the neighborhoods on both sides of the channel would improve under either dredge Alternative 1 or Alternative 2. Alternative 2 offers the potential for better access, through a jogging, walking and bicycling path proposed for the top of the concrete pile caps. This path would be able to tie into the "linear park" already in place in western CMP, and provide wide views of the water and other city sights.

4.11 RECREATION

Completion of the recommended dredge alternative would provide a new water-side trail for jogging, walking or cycling, and other water access points for wildlife viewing, boating or fishing. This would only be practical if great water quality improvements are expected. Under Alternative 1 the trail feature could be built through the mangroves, but it would require elevation on a boardwalk. Under the minimal alternative water quality improvement would be so slight as to foreclose the possibility of developing water access points for fishing or boating.

4.12 NAVIGATION

The recommended plan would provide a wide channel for private small vessel navigation, and might even provide access for a small passenger ferry system. Vessel size would be limited by the clearance under the arches of the Ponce de Leon Avenue Bridge, which would remain in place under Alternative 1 as well.

4.13 CULTURAL RESOURCES

The Ponce de León Avenue bridge is historically significant and eligible for inclusion on the National Register of Historic Places. This bridge would not be affected under any alternative, including the recommended plan, although dredging will occur in the channel on both sides of the bridge. Neither the Luis Muñoz Rivera or Barbosa Avenue bridges are eligible for inclusion on the National Register. No historically significant standing structures or significant archeological deposits will be affected by any of the dredging alternatives. The preferred disposal alternative, disposal in deep holes in San Juan Lagoon, and the existing landfill disposal alternative will not affect historic properties. Effects to historic properties from the other disposal alternative, new landfill creation, were not assessed.

4.14 SOCIO-ECONOMIC EFFECTS

Construction of Alternative 1 or Alternative 2, with all the related infrastructure improvements, should greatly improve the attractiveness of the area, remove a major source of bad odors, and potentially generate new incomes derived from recreational use of the channel. Alternative 2, the recommended alternative, makes provision for future navigation in the channel, opening the potential for a citywide public water transport system, although no such system is currently planned. Even under the no-dredge alternative the neighborhoods are expected to improve, as city infrastructure services are planned to be replaced and redesigned in parallel with channel improvements.

4.15 PUBLIC SAFETY

Caño Martín Peña is not readily accessible at present. It is a safety and health hazard to small children at present, because of the soft, yielding black mud on its bottom and sides, the opacity of the water, and its high bacteria counts The sheet pile walls and bordering mangroves, after they are built, will constitute a barrier, except at planned access points, to the water. All public recreation facilities (including the bicycle path/jogging trail) will be constructed with safety features including lights, handrails and other features to prevent accidental During construction, public access will be controlled for safety.

4.16 ENERGY REQUIREMENTS AND CONSERVATION

This project will not place an inordinate demand on fossil fuel or other energy. Once construction is complete, it will be a passive project, requiring no energy to function, other than tidal and wind energy.

4.17 NATURAL RESOURCES

The most valuable natural resource in the area is the Channel itself, and the quality of its waters. In an urban context, these waters are potentially a source of visual relief, recreation, fishing, and they could constitute significant wildlife habitat. The first purpose of the proposed action is restoration of the chemical and physical quality of the water body. Implementation of the project would be a significant step in a series of actions designed to restore overall water quality in the San Juan Bay Estuary system.

4.18 CUMULATIVE IMPACTS

Cumulative impacts are those impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative effects of development in the greater San Juan area have led to a great loss of mangrove cover and degradation of the chemical and physical quality of the surrounding estuarine waters. This project will not affect the overall rate of development of surrounding neighborhoods. Dredging the western half of Caño Martín Peña in 1987 improved water quality in this part of the canal for a brief period of time, without requiring removal of most of the channel's mangrove cover. However, this action alone did not halt the gradual sedimentation and fouling of the eastern half, nor did it contribute much to restoring circulation between San Jose Lagoon and San Juan Bay. Cleaning out the eastern half of the channel, in conjunction with the prior action, should significantly improve water quality throughout the system, because it will remove a major impediment to circulation and allow flushing to continue into the future, especially if the project is maintained. No adverse cumulative impacts are expected.

4.19 IRREVERSIBLE EFFECTS OR IRRETRIEVABLE COMMITMENTS

No irreversible or irretrievable commitment of existing resources is expected to result from this proposed work

4.20 UNAVOIDABLE ADVERSE EFFECTS

Other than the short-term turbidity increases and adverse effects on oxygenation of the water column expected in the channel during actual dredging, no unavoidable adverse effects on the environment are expected. The existing environment is so urban, and the channel's waters are so black, opaque and anaerobic now, that these short-term increases are not expected to be significant. In contrast, once dredging is finished channel water quality, both transparency and dissolved oxygen, are expected to improve dramatically.

4.21 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES AND MAINTENANCE/ENHANCEMENT OF LONG-TERM PRODUCTIVITY

CMP is not currently providing any short-term uses, except to function as the sump at the "bottom" of the drainage of southern Santurce and northern Hato Rey. Any of the studied alternatives would increase short-term productivity over existing conditions.

4.22 INDIRECT EFFECTS

Perhaps the most important indirect effect of the proposed project would be its incremental effect on improving water quality throughout the wider estuary of San

Juan, especially if the dredged material is used to plug the deep holes in San Jose Lagoon, and then future dredging projects follow-up until these holes are all filled and capped at the original level of the lagoon bottom. San Jose was originally a shallow (5-6' deep) water body, and it was kept well mixed and aerobic by the wind. The deep holes are acting as traps to prevent re-aeration of the water, as they accumulate oxygen-demanding materials that arrive there from surface runoff. It is hoped by the proponent agencies that this incremental step (dredging the channel) also demonstrates the viability of implementing a system wide series of improvements in other infrastructure features, which continues until the quality of the surrounding waters and cityscape is also improved.

4.23 COMPATIBILITY WITH FEDERAL, STATE AND LOCAL OBJECTIVES

The proponents believe that the proposed project is compatible with Federal and Commonwealth objectives such as improving water quality, improving or restoring navigation, improving the quality of urban life in San Juan, restoring the San Juan Bay Estuary System, improving fish habitat quality in the urban bays and lagoons, reorganizing city infrastructure, including public transportation, water, sewer and road networks. The project has been coordinated with the Urban Train Project, the Cantera Peninsula restoration project, and other Commonwealth-Federal-non-government projects that are ongoing in the area.

4.24 WETLANDS MITIGATION

A mitigation plan for mangroves lost under the channel footprint is described in Chapters 2 and 4 of this DEIS. Unless Disposal Alternative 3 is recommended, no further mitigation should be necessary. In general, the primary purpose of the proposed project is environmental restoration of a badly clogged body of open water. Results of the "desktop" E-WRAP suggest that no mitigation is needed for loss of the forested wetlands (mangroves) other than their replacement within the project footprint, and that even at a 1-to-1 ratio (by acreage) this action should result in enhancement of wetland function.

5 COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

5.1 NATIONAL ENVIRONMENTAL POLICY ACT OF 1969 (NEPA)

Environmental information on the project has been compiled and this Environmental Impact statement, dated February 28, 2001 has been prepared. This EIS will begin circulation at some time after it is accepted, along with a Permit Application for the proposed project, by the U.S. Army Corps of Engineers. Generally the USACE would first circulate a Public Notice that would inform the Public of its intent to prepare and circulate an EIS. The public notice, in addition to its circulation to the USACE Puerto Rico mailing list, would appear in the Federal Register. At that time agencies or individuals wishing to comment further on the issues would have time to do so. Should additional issues arise as a result of the Federal Register or Pubic Notices, they would be incorporated into this document. Since this Draft did not have the opportunity to incorporate such public comment, it is not yet compliant with NEPA.

5.2 ENDANGERED SPECIES ACT OF 1973

In early scoping with the National Marine Fisheries Service and US Fish and Wildlife Service, no endangered species or habitat was identified in CMP. (Refer to Appendix C). The proposed project is in compliance.

5.3 FISH AND WILDLIFE COORDINATION ACT OF 1958

This project has been coordinated with the U.S. Fish and Wildlife Service (USFWS) only during general scoping. Comments have been submitted by the USFWS and responded to by the Corps and proponent in interagency meetings held in San Juan, especially as the project was discussed in SJ Bay Estuary Program Technical meetings. As an uncirculated D-EIS, this document is in compliance with the requirements of the Act at this time.

5.4 NATIONAL HISTORIC PRESERVATION ACT OF 1966 (*INTER ALIA*)

Archival research and consultation with the SHPO have been initiated in accordance with the National Historic Preservation Act, as amended; the Archeological and Historic Preservation Act, as amended and Executive Order 11593. SHPO consultation was initiated July 23, 1996. The project will not affect historic properties included in or eligible for inclusion in the National Register of Historic Places. At this time coordination has not been completed. The project is in partial compliance with each of these Federal laws.

5.5 CLEAN AIR ACT OF 1972

The affected airshed is not a non-compliance area. No air quality permits would be required for this project.

This project will be coordinated with concerned agencies, including the U.S. Environmental Protection Agency (EPA), and the public, and will then be in partial compliance with Section 309 of the Act.

Correspondence from EPA can be found in Appendix C. Discussion of any issues therein can be found in the Public and Agency Involvement section of this statement.

5.6 CLEAN WATER ACT OF 1972

Present waters of CMP are mostly in violation of Environmental Quality Board primary water quality standards, for dissolved oxygen, turbidity, and coliform bacteria. The proposed project would improve water quality in the canal and adjacent water bodies, and therefore is in compliance with this Act. A Section 401 water quality certification cannot be applied for until the NEPA process is complete, according to Commonwealth Environmental Quality Board regulations. All Commonwealth water quality standards would be met. A Section 404(b) evaluation is included in this report as Appendix A.

5.7 COASTAL ZONE MANAGEMENT ACT OF 1972

A federal consistency determination in accordance with 15 CFR 930 Subpart C is included in this report as Appendix B. Puerto Rico consistency review will be performed prior to coordination of the final EIS.

5.8 FARMLAND PROTECTION POLICY ACT OF 1981

No prime or unique farmland would be impacted by implementation of this project. This act is not applicable.

5.9 WILD AND SCENIC RIVER ACT OF 1968

No designated Wild and Scenic river reaches would be affected by project related activities. This act is not applicable.

5.10 ESTUARY PROTECTION ACT OF 1968

CMP is part of the San Juan Bay Estuary System. The proposed action is one of the adopted Strategies to improve water and sediment quality of the system, as described in the Comprehensive Conservation and Management Plan- CCMP- for the Estuary. The project is in compliance.

5.11 RIVERS AND HARBORS ACT OF 1899

The proposed work would not obstruct navigable waters of the United States. The proposed action would require a permit from USACE if undertaken by agencies of the Commonwealth of Puerto Rico. When the permit application is submitted the proposed action would be subject to the public notice, public hearing, and other evaluations normally conducted for activities subject to the act. The project is in full compliance.

5.12 ANADROMOUS FISH CONSERVATION ACT

Anadromous fish species would not be affected. The project has been coordinated with the National Marine Fisheries Service and is in compliance with the Act.

5.13 MIGRATORY BIRD TREATY ACT AND MIGRATORY BIRD CONSERVATION ACT

The Puerto Rico Department of Natural and Environmental Resources administers this Act in Puerto Rico, and has endorsed the Recommended Plan as its preferred alternative. There is minimal migratory bird habitat along the channel at present. Completion of the recommended plan will lead to a net increase in perching and resting habitat for migratory bird species. The project is in compliance with these acts.

5.14 MARINE PROTECTION, RESEARCH AND SANCTUARIES ACT

Early in the study, it was determined that materials proposed for dredging were not eligible for offshore disposal. Therefore, the Marine Protection, Research and Sanctuaries Act does not apply to this project. The disposal activities addressed in this EIS have been evaluated under Section 404 of the Clean Water Act.

5.15 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

Coordination with NMFS has been initiated. At the time of submission of a Corps Permit application, coordination would be expected to be completed (refer to Appendix C, "Public and Agency Coordination").

5.16 E.O. 11990, PROTECTION OF WETLANDS

This project is in compliance with the goals of this Executive Order. A desktop application of "EWRAP" indicated that wetlands functioning would be enhanced by the proposed action and included mitigation by replanting 8 acres of mangroves. Overall water and wetlands quality would be enhanced.

5.17 E.O. 11988, FLOOD PLAIN MANAGEMENT

The project is in the base flood plain (100-year flood) and has been evaluated in accordance with this Executive Order. Because the problem water body is at the bottom of a flood plain, no other alternative location makes sense. However, though not a flood control project, note that the preferred alternative provides an incidental increase in on-site flood retention. The project is in compliance.

5.18 E.O. 12898, ENVIRONMENTAL JUSTICE

This Executive Order seeks to assure the participation of disadvantaged and minority groups in government decisions that would affect them. It further requires full evaluation of the potential impact of Federally funded projects on such groups, to avoid adverse project siting (primarily due to cost considerations) or a disproportionately adverse impact on minorities or disadvantaged groups. In the case of eastern Martín Peña, nearly the entire residential population of both sides of the channel could be characterized as low-income, although they do not belong to an identifiable ethnic or cultural minority in comparison to the population of Puerto Rico or San Juan. The study and recommended project would provide the most benefit to residents who live closest to the channel, for they are the ones whose residences flood and who are most aware of the current health and safety deficiencies in CMP. Housing located closest to the channel is subject to frequent flooding during heavy rainstorms, where the channel's diminished conveyance capacity causes runoff water to back up in adjacent streets and first floors. About 460 residences immediately adjacent to the channel are likely to be displaced, and would be relocated by Commonwealth agencies, under the preferred alternative, where one extremely tight bend of the channel would be slightly straightened. In contrast to the several thousand residents in similar social and economic circumstances who would benefit, this is not thought to be a disproportionately severe impact. Affected groups have already been informed about the planning and design process and have been provided opportunities to ask questions and comment. Coordination meetings have been held in neighborhoods on both sides of the channel, both by the Corps and during the SJBEP's development of its CCMP, of which this dredging project is a component.

When the Federal permitting process is triggered by submission of an application for a Corps Permit (or previously, if the Proponent decides to go through the Commonwealth EIS process first), the public will be assured ample opportunities to request public meetings, public hearings and other information exchange, for full opportunities for public participation are required under Federal and Commonwealth laws related to environmental policymaking.

6 LIST OF PREPARERS

6.1 PREPARERS

This Draft EIS was prepared by Esteban Jiménez , Biologist, and Jorge Tous, Civil Engineer, of the U.S. Army Corps of Engineers Jacksonville Planning Division and Antilles Planning Group. The sections discussing cultural resources were prepared by David L. McCullough, Archeologist.

6.2 REVIEWERS

This Draft EIS was reviewed by Lizabeth Manners, Acting Chief, Environmental Studies Section, Environmental Branch, Jacksonville, by Barbara Cintrón, Biologist, Jacksonville District and by Jose Martínez, Section chief Antilles Planning Section, Jacksonville District.

7 PUBLIC AND AGENCY INVOLVEMENT

7.1 SCOPING AND PUBLIC MEETINGS

Federal Actions currently related to this project include implementation of the SJBEP's Federally-subsidized Comprehensive Conservation and Management Plan (which endorses dredging eastern CMP as a water and sediment quality improvement action) and Corps preparation of a Final Design Report and a DEIS to the sponsor. During the preparation of these documents the Corps and the San Juan Bay Estuary Program initiated early public information activities, with significant assistance from the Cantera Development Project, the San Juan Municipal Planning Department, the Planning Board and other agencies. Dredging Martín Peña Channel is a water and sediment quality improvement strategy endorsed by the SJBEP. This DEIS was begun "as if" it were for a federal project. The Corps began preliminary coordination, equivalent to early "scoping", but no Notice of Intent was published in the Federal Register. Scoping letters were circulated to Puerto Rico and Federal agencies on July 23, 1996, notifying them that the Corps was studying the problem at the request of the Government of Puerto Rico, and requesting issues, concerns and recommendations. A second scoping and information letter was sent in October 1997, when model results and sediment test results were available, showing that dredged materials were not eligible for offshore disposal. The project was further discussed at a Technical Committee Meeting of the San Juan Bay Estuary Program in December, 1997, and at a Regulatory interagency meeting in September, 1998. The project was endorsed by the Draft and Final Comprehensive Conservation and Management Plans (1998 and 2000, respectively) of the SJBEP. A series of public meetings has been held in affected neighborhoods to explain report recommendations. The potential dredging action was also discussed during public meetings to present the findings of the CCMP for the San Juan Bay Estuary Program.

Public meetings included the following: 1) June 8, 1999, north Hato Rey (Las Monjas), to present the Corps results and recommendations and inform the citizens about potential relocations; about 50 citizens and government representatives in attendance; 2) November 4, 1999, Sagrado Corazon University, Santurce, during a public meeting to present the CCMP, with 60 attendees; 3) November 15, 1999, during a public meeting to present the CCMP, at Las Monjas (Hato Rey), attended by about 20 citizens; 5) November 24, 1999, during a public meeting to present the CCMP, in Cantera (Santurce), attended by about 30 citizens; 6) March 23, 2000, Barrio "Marina" (Santurce), public meeting to explain the Corps report and probable relocations; about 70 citzens attending; 7) June 29, 2000, in Barrio Buena Vista, to present the Corps report; about 40 attendees.

7.2 COMMENTS RECEIVED

Comments received to date are compiled in Appendix C.

8 REFERENCES

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APPENDIX A

CLEAN WATER ACT SECTION 404 (B) (1)

EVALUATION

APPENDIX A - SECTION 404(B) EVALUATION, CANO MARTIN PENA DREDGING

Project Description

A. Project Location. Caño Martín Peña is located in San Juan, Puerto Rico. It is a meandering, heavily sedimented tidal channel that connects Laguna San Jose, on the east, with inner San Juan Bay, on the west. The easternmost 11,600 feet of Caño Martín Peña (CMP), stretching from Avenida Muñoz Rivera to San José Lagoon, are under consideration for dredging to an average depth of 10 feet MLW and an average width of 150 to 200 feet. The recommended plan contemplates disposal of the dredged material in deep, anaerobic holes in Laguna San José (and possibly Laguna Los Corozos, a cove of San José.

B. General Description. The Federal Action under consideration is issuing an Individual Permit to dredge 750,000 cubic yards of fill from the easternmost 11,600 feet of Caño Martín Peña, creating a vertical-walled, sheet pile reinforced rectangular channel to improve water flow from coastal lagoons east of San Juan Bay, through the Channel, and into the Bay itself. Included as a consequence of the considered action is conversion of 8 acres of mangrove-dominated channel banks into open water. This action is required to achieve the necessary channel cross-section, as the mangroves are growing on sediments within the channel itself. Proposed mitigation consists of creation of 9 acres of new mangrove stands, in contact with channel waters, behind the steel sheet pile bulkheads, with tidal flow to be provided by a "lost panel" design.

C. Authority and Purpose. The proposed project was designed by the Planning and Engineering Divisions, U.S. Army Corps of Engineers Jacksonville District, under Support for Others authorities. The Puerto Rico Government, through its Department of Natural and Environmental Resources (DNER) is the sponsor that would apply for Federal permits. Permits will be sought under authority of Section 10 of the Rivers and Harbors Act of 1899, as amended, and Section 404 of the Clean Water Act of 1972, as amended.

D. General Description of Dredged or Fill Material. The materials filling the channel are a combination of sediments originating in the adjacent uplands, and fill consisting of sandy material, domestic and construction debris.
Debris may include concrete and brick rubble, soil, metals including vehicle parts, metal roofing, appliance parts, and plastics.

E. Description of the Proposed Discharge Site(s). Discharge is proposed into existing deep, anoxic holes at the bottom of San José Lagoon and Los Corozos Cove, as illustrated in the Main Design Report. Materials will be barged to the disposal sites, which will be encircled with debris curtains reaching to the lagoon bottom. Floating debris will be removed at pre-disposal staging areas and trucked to an upland landfill.

After filling to a depth of 2 feet below the average bottom depth, the disposal holes will be capped with clean, select fill up to average bottom depth.

(1) Location (map). The disposal sites are located about 4 miles east (by water) from the center point of the dredge site, in San José Lagoon. The sites are illustrated in the Design Report.

(2) Size (acres). Both sites, in aggregate, cover about 5 acres. They have an aggregate capacity of over 750,000 cubic yards of material, thus can accommodate fill from any dredging alternative considered.

(3) Type of Site: Disposal is proposed into two deep man-made holes in an open water estuarine lagoon, to be confined inside a circular sediment curtain during disposal. The holes are further confined by nature of their configuration (conical depressions on the lagoon bottom).

(4) Type(s) of Habitat. The disposal sites are deep holes in an otherwise shallow, sandy-bottomed estuarine lagoon, currently poorly mixed and subject to frequent fish kills. This lagoon does not have submerged aquatic vegetation. It is habitat for a mixed population of estuarine fishes, particularly ***Gerridae*** ('mojarras'). The deep holes are overlain by anaerobic water and do not support fish or invertebrate populations.

(5) Timing and Duration of Discharge. Discharge will be concurrent with dredging operations at CMP, which are expected to last about 12-18 months.

(6) Actions taken to minimize impacts. The following actions have been incorporated into project plans to minimize adverse effects at the disposal sites: (i). Dredged material, prior to barging to the disposal sites, will be sorted in a staging area. All floatable material and debris unsuitable for disposal in the lagoon bottom will be segregated and trucked to an approved upland landfill; (ii) A sediment curtain will be installed around each disposal site when it is in use, to retain the fine materials inside until such time as they settle out of the water column. These sediment curtains will extend from the surface to the bottom of the lagoon (about 5.5 feet, outside the holes); holes, once filled up to within -2 feet of the surrounding lagoon bottom, will be capped by clean, select material up to the surrounding bottom contour..

F. <u>Description of Disposal Method.</u> Disposal will be by direct mechanical deposit from the dredge's barge, which will be floated over the site through an encircling sediment curtain.

II. Factual Determinations

A. Physical Substrate The area proposed for dredging is filled with deep fine sand and silt with debris inclusions. The disposal areas consist of deep holes in a lagoon that is otherwise very shallow, with a fine sandy bottom. The holes were produced during underwater sand mining that occurred during the mid-Twentieth Century. The bottom of the holes is lined with fine material. These holes trap fine silt and organic matter originating in urban runoff, and are believed to be one cause, along with blocked tidal flow, for the poor water quality of San Jose Lagoon.

(1) Substrate elevation and slope. The holes are at depths of -20 to -28 feet (MLW). They can generally be described as cone-shaped depressions. Surrounding bottoms slope sharply down into the holes.

(2) Sediment type. Disposal area sediment is fine, silty sand. It is similar to the dredged material in texture (except for man-made debris)

(3) Dredged/fill material movement: Installation of a cap of select material will not allow movement of dredged material.

(4) Physical effects on benthos: Benthos of San Jose lagoons is sparse in the area of the deep holes due to oxygen deficient waters. Some marine worms may constitute the only fauna. This benthos is not unique, and it will be buried by deposition of dredged material. Recolonization from adjacent areas is expected to be rapid.

(5) Other effects: The conical shape of the holes, in combination with the sediment curtain, will serve to concentrate the disposed material in the center of each depression and further inhibit movement.

B. Water Circulation, fluctuation and salinity determinations.

(1). Water Quality San Jose is an estuarine water body whose salinity fluctuates widely and rapidly, especially during the rainy season. Generally, salinity ranges from about 10-25 parts per thousand (ppt). Most of the Lagoon is shallow enough (4.5-5.5 feet MLW) to be wind-mixed. Sea water enters through Canal Suárez, on the northeastern side of the Lagoon while fresh water enters through a series of streams along the south side. Tidal outflow exits through both Caño Martín Peña, when this canal is not blocked, and Canal Suárez. At the present time nearly all tidal exchange (inflow and outflow) is through Caño Suárez, because Martín Peña is blocked. Puerto Rico has a micro-tidal regime, and near-complete blockage of eastern Martín Peña has reduced the volume of tidal exchange through this water body to near-zero. Studies of the channel-lagoon system in the early 1970's found a net flow to the west, and a maximum tide level fluctuation of 6-8" (Ellis and Gómez-Gómez, 1976a,b).

(2) Water Chemistry. Water salinity is in the mid-estuarine range. It may vary from nearly seawater conditions (25 ppt) at the end of a rain-free period to 5 ppt or less after heavy, flooding rainfall. Average salinity is about 15 ppt, or one-half seawater concentration. Waters have shown widely fluctuating dissolved oxygen readings. Daytime readings are high enough to place these waters in the eutrophic range (supersaturation). Total nitrogen and phosphorus concentrations are also high. The lagoon waters are clearer than San Juan bay, except in the western end near Martin Peña, but they have a yellow-green color, indicating presence of high concentrations of planktonic algae and blue-green bacteria.

(3) Conventional water quality parameters. The Lagoon is an urban water body. Coliform bacteria counts as indicators of fecal contamination are high. As a coastal lagoon, it is not a source of potable water, and the parameters such as taste and odor are not applicable.

(4) Current patterns and circulation. (Refer to Tides, above) Wind mixing is the most important factor influencing water re-aeration and circulation. Net flow, when measured, was from east to west, reflecting a trade-wind pattern. San Jose lagoon is too shallow and wind-mixed to show a density stratification, except over the deep holes mentioned previously. Water inside the deep holes may become stratified, with the bottom water completely anoxic. Under these conditions sulfide levels may become toxic in waters overlying the holes, resulting in localized fish kills. No salinity gradients have been observed in San Jose Lagoon, which is generally too well -mixed by the wind to stratify.

(5) Normal water level fluctuations. Few data on Lagoon level fluctuations are available. Lagoon waters may flood adjoining streets during unusually heavy seasonal rains. The measured tidal range in Laguna San Jose was on the order of 6-8".

C <u>Suspended Particulate/Turbidity Determinations</u>.

(1) Expected changes in suspended particulates and turbidity levels at the Disposal site. During disposal, some transitory increases in turbidity may occur, in spite of the sediment curtain, due to resuspension of the finest components of the sediments being deposited in the lagoon. These changes will not result in violation of the Puerto Rico Water Quality Standards Regulation. No movement of a turbid plume is expected, due to the sheltered location of the disposal site and use of an encircling sediment curtain. Capping the site, once full, will completely inhibit any lasting turbidity effects when dredging is finished.

(2) Effects of changes. No adverse effects on Lagoon primary productivity, plankton, nekton, suitability as fish habitat, or other biologic characteristics are expected. No adverse effects on endangered or threatened species are believed likely. San Jose lagoon is populated by a series of tolerant estuarine organisms that are resistant to a wide fluctuation of physical and chemical conditions in the environment. A short term decrease in primary productivity over a limited area of Lagoon surface, due to temporarily lowered water transparency and dissolved oxygen during disposal, will be followed by a significant overall improvement in habitat conditions of lagoon water once wind and tidal mixing is re-established. Disposal will not introduce toxic substances or pathogens nor will it adversely affect the biota of waters surrounding the disposal site.

(3) Effects on Special Aquatic Sites. San Jose and Los Corozos Lagoons are part of the greater San Juan Bay Estuary system. Dredging CMP is an adopted strategy of the San Juan Bay Estuary Program, codified in the Comprehensive Conservation and Management Plan (CCMP) of the Program as a water and sediment quality improvement strategy. The CCMP strategy is to identify materials to refill as many of the existing holes as possible, thereby fostering more complete wind-mixing and reaeration of the lagoons. The function and strategy was modeled and validated, in part, by the Waterways Experiment Station hydrodynamic model of the larger estuary system.

D. Contaminant Determinations. The firm Roy F. Weston Inc. completed a site characterization study of Caño Martín Peña on August 1997, including chemical analysis and geotechnical testing, of sediment and water samples from canal, canal side and lagoon locations. Subsequent testing of soil and water samples from test pits within the excavation area was done by ECG, Inc., in June 1998. Soils in the area showed elevated total lead and mercury concentrations, but still below thresholds for determination as toxic or hazardous. Capping of the site with clean material will prevent any leaching of the relatively immobile heavy metals into the overlying water column.

E. Aquatic Ecosystem and Organism Determinations. The proposed discharge will re-level the bottom of San Jose Lagoon, while dredging Caño Martín Peña will increase water flow to San Juan Bay and decrease turnover time for water in San Jose Lagoon. Both effects should increase lagoon water clarity and increase primary productivity, improve fish habitat and allow a greater diversification in the Lagoon plankton. This will positively affect Lagoon fish populations. At present and for many years, San Jose has been the site of repeated fish kills, as anoxic water episodes are fairly common. These episodes are believed to be due in part to the eutrophic, poorly flushed condition of the lagoon water column, the existence of deep oxygen traps and the toxic effect of turnover or mixing of water from these traps with the general lagoon waters during flood or high wind episodes. Benthos at the disposal sites, believed to consist largely of bacteria and marine worms, will be buried. Overall, re-leveling the bottom of the lagoons is expected to exert a largely beneficial effect.

No special aquatic sites, coral reefs, seagrass beds, or mangroves will be affected by discharge of dredged materials. The lagoon itself is part of the greater San Juan Bay Estuary. The San Juan Bay Estuary Program has endorsed the concept of dredging Caño Martín Peña with disposal in the holes in the Lagoon bottom.

F. Proposed Disposal Site Determinations

(1) Mixing Zone. No mixing zone has been determined for this discharge.

(2) Compliance with Water Quality Standards. Water Quality Standards for Class C coastal waters of Puerto Rico will be complied with. No toxic effluents, as described under Section 307 of the Clean Water Act, will be discharged.

(3) Discharge of dredged materials will not affect human use characteristics of San Jose Lagoon, municipal or private water supplies, or recreational or commercial fisheries. San Jose lagoon does not at present provide significant habitat for the marine fish species managed by the Caribbean Fisheries Management Council. Fish habitat value of the lagoon is expected to improve after the dredging project is finished and re-aeration of Lagoon water becomes more effective.

(4) Discharge of dredged materials at the proposed site will not adversely affect recreational use of the water body (including recreational fisheries) or aesthetics.

(5) Cumulative and secondary effects of discharge on the ecosystem are all expected to be positive. The dredged materials will be capped by 2 feet of clean fill. Dredging Caño Martín Peña, and discharge of the dredged materials into the deep holes in San Jose Lagoon, followed by their capping, are expected to jointly improve water quality in the very center of the San Juan Bay Estuary circulation system. Wide-ranging positive secondary effects are expected. Improvements in water quality are projected as far west as inner San Juan Harbor and as far east as the eastern side of San Jose Lagoon.

III Finding of Compliance With Restrictions on the Discharge.

(1) No significant adaptations of the Section 404 guidelines were made relative to this evaluation.

(2) No other practicable alternatives were able to be developed. Initially, ocean disposal was expected to be the preferred method of discharge. However, early investigations of sediment composition by Corps contractors revealed that the dredged materials had a significant component consisting of domestic debris. This material is

ineligible for ocean disposal and double-handling of the dredged material would have been prohibitively costly. A second, upland disposal alternative was studied. However, the only site both undeveloped, large enough and near enough to the work site to make the project economically viable was determined to be jurisdictional wetland. Although this alternative would be feasible it would require conversion of more than 20 acres of emergent wetlands to landfill, and would provide no water quality improvement benefits such as those expected as a result of filling the deep holes in San Jose Lagoon.

(3) This work will not cause any harmful effects on water transparency, chemical composition (including dissolved oxygen, DO), or environmental condition of Caño Martín Peña (CMP) and the San José and Los Corozos lagoon system. On the contrary, widening and deepening CMP will improve water circulation and reduce concentration of nutrients and contaminants. Filling the holes in the lagoon bottom will improve lagoon circulation and eliminate deep, anoxic sediment traps. The proposed work is in compliance with all parts of Section 404 of the 1972 Clean Water Act. It will comply with the Puerto Rico Water Quality Standards Regulation. A Water Quality Certificate (WQC) will be sought from the Puerto Rico Environmental Quality Board (EQB).

(4) No toxic effluents, as described under Section 307 of the Clean Water Act, will be discharged at the site. No adverse effects on endangered species are expected.

(5) There will be no adverse effects on marine protected areas, human health and welfare, private water supplies, recreation and commercial fisheries, biota, or aquatic ecosystem diversity, productivity and stability.

(6) The following practicable steps have been taken to minimize potential adverse impacts of the discharge:

a. A sediment curtain, completely encircling the discharge area, will be in place at all times to prevent escape and re-suspension of fine sediments, or their introduction into the greater lagoon system;

b. The holes will be filled only to within about 2 feet below the surrounding lagoon bottom. Then they will be capped with a minimum cap of 2 feet of clean, select material, so as to immobilize the dredged material and isolate it from the water column.

(7) On the basis of the guidelines, the proposed disposal sites for the discharge of dredged material is specified as complying with the requirements of these guidelines.

APPENDIX B

PUERTO RICO COASTAL ZONE

DETERMINATION OF CONSISTENCY

APPENDIX B

DETERMINATION OF CONSISTENCY WITH

PUERTO RICO COASTAL ZONE MANAGEMENT PROGRAM

(AND FORM JP-833)

The following pages reproduce, in reduced form, the completed Puerto Rico Planning Board JP-833 for the dredging of the eastern half of Caño Martín Peña (CMP) Channel. The Corps has determined that this dredging work is consistent with the Coastal Management Program for Puerto Rico, for the following reasons:

1. The work will enhance the water flow, wind mixing and tidal exchange in San Jose Lagoon. It will improve water quality in Caño Martín Peña and provide some incidental flood retention benefits.

2. Recreation elements developed at the request of local sponsors include a channel-side running and bicycing path, with canal access points. The channel will be accessible to small motor boats, canoes and kayaks.

3. Mangroves removed to widen the channel will be replaced on-site by creation of mangrove areas behind the sheet pile channel walls. A "lost panel" design will allow for tidal flushing of these mangroves.

4. Sport fishing in San Jose Lagoon should improve, as water quality improves.

5. Dredging eastern CMP has been adopted as a water and sediment improvement strategy of the San Juan Bay Estuary Program's Comprehensive Conservation and Management Plan (SJBEP, 2000).

The Corps has made a preliminary determination that the Martín Peña dredging project is consistent with the Puerto Rico Coastal Management Program.

JP-833
Rev. Dec. 98

Government of Puerto Rico
Office of the Governor
Puerto Rico Planning Board
Physical Planning Area
Land Use Planning Bureau

Application for Certification of Consistency with the Puerto Rico Coastal Management Program

General Instructions:

A. Attach a 1:20,000 scale, U.S. Geological Survey topographic quadrangular base map of the site.

B. Attach a reasonably scaled plan or schematic design of the proposed object, indicating the following:

1. Peripheral areas
2. Bodies of water, tidal limit and natural systems.

C. You may attach any further information you consider necessary for proper evaluation of the proposal.

D. If any information requested in the questionnaire does not apply in your case, indicate by writing "N/A"(not applicable).

E. Submit a minimum of seven (7) copies of this application.

DO NOT WRITE IN THIS BOX

Type of application: ____________ Application Number: ____________

Date received: ____________ Date of Certification: ____________

Evaluation result: ☐ Objection ☐ Acceptance ☐ Negotiation

Technician: ____________ Supervisor: ____________

Comments: ____________

1. Name of Federal Agency: U.S. Army Corps of Engineers
2. Federal Program Catalog Number: 12.109 Protection, Clearing & Straightening Channels
3. Type of Action:

☐ Federal Activity ☐ License or permit ☒ Federal Assistance

4. Name of Applicant: Puerto Rico Dept of Natural & Environmental Resources

Postal Address: DNER Box 9066600 Pta. de Tierra Sta. Puerto Rico 00906

Telephone: 787-723-2055 Fax: 787-723-4255

5. Project name: Cano Martin Pena Environmental Restoration
6. Physical Description of Project Location (area, facilities such as vehicular access, drainage, storm and sanitary sewer placement, etc.): The western most 11,600 feet of Cano Martin Pena (CMP)

Lambert Coordinates: X = ____________ Y = ____________

7. Type of construction or other work proposed:

☐ drainage ☐ channeling ☐ landfill ☐ sand extraction

☐ pier ☐ bridge ☐ residential ☐ tourist

others (specify and explain) Drainage/enhancement of Cano Martin Pena (CMP) Canal.

Description of proposed work: Dredge 750,000 cu yds. of the eastern most ~~11,000~~ fe of Cano Martin Pena and install support siding. Dredge material disposal at San Jose Lagoon Deep Holes.

8. Natural, artificial, historic or cultural systems likely to be affected by the project

Place an X opposite any of the systems indicated below that are in the project area or its surroundings, which are likely to be affected by that activity. Indicate the distance from the project to any outside system that would likely be affected.

System	Within Project	Outside Project	Distance (meters)	Local name of affected system
beach, dunes				
marshes				
coral, reefs				
river, estuary	X		0	Martin Pena
bird sanctuary				
pond, lake, lagoon		X	6,000	San Jose
agricultural unit				
forest, wood				
cliff, breakwater				
cultural or tourist area				
other (explain)				

Describe the likely impact of the project on the identified system (s).

Positive ☒ xx Negative ☐

Explain: The work will allow a more rapid flow of water, resulting in increased waterflow and an improvement in water quality. Fill of deep holes in San Jose Lagoon will eliminate existing anoxic focii.

9. Indicate permits, approvals and endorsements of the proposal by Federal and Puerto Rican government agencies. Evidence of such support should be attached to the proposal.

	Yes	No	Pending	Application Number
a. Planning Board	☐	☐	☐	______________
b. Regulation and Permits Administration	☐	☐	☐	______________
c. Environmental Quality Board	☐	☐	☐	______________
d. Department of Natural Resources	☐	☐	☐	______________
e. State Historic Preservation Office	☐	☐	☐	______________
f. U.S. Army Corps of Engineers	☐	☐	☐	______________
g. U.S. Coast Guard	☐	☐	☐	______________
h. Other (s) (specify)	☐	☐	☐	______________

CERTIFICATION

I CERTIFY THAT (project name) Dredging Cano Martin Pena ______ is consistent with the Puerto Rico Coastal Zone Management Program, and that to the best of my knowledge the above information is true.

______________________ Name (legible)

______________________ Signature

______________________ Position

______________________ Date

APPENDIX C

PERTINENT CORRESPONDENCE

APPENDIX C - PERTINENT CORRESPONDENCE

The following agencies and entities received scoping letters regarding design of the Martín Peña dredging project. Agency comments received are summarized on following pages.

Department of Natural and Environmental Resources
P. R. Planning Board
P. R. Environmental Quality Board
P.R. Office of Budget and Management
P.R. Civil Defense
P.R. Aqueduct and Sewers Authority
P.R. Telephone Company
P.R. Electric Power Authority
P.R. Department of Recreation and Sports
P.R. Department of Transportation & Pub. Works, Highways Authority
San Juan Mayor's Office

Federal Agencies

U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service, Caribbean Field Office
U.S. Dept. of Agriculture, Natural Resources Conservation Service
U.S. Geological Survey, Caribbean Field Office
Federal Emergency Management Agency

Comments received during scoping for this report and DEIS.

Scoping letters were circulated on July 23,1996, and on October 1997, when model run results and soil testing information were available. The project was endorsed by the Draft and final Comprehensive Conservation and Management Plans (1998 and 2000, respectively) of the San Juan Bay Estuary Program. Early Comments are reproduced below:

U.S. Fish and Wildlife Service (USFWS) - August 6, 1996. Recommended disposal of the dredged material in the adjacent lagoon systems. ***R: this is the alternative that is recommended for dredged material disposal.***

State Historic Preservation Office (SHPO) - August 19, 1996. Stated the Martín Peña Bridge (on Ponce de León Avenue) was eligible for inclusion in the National Register of Historic Places and formally recommended that this structure should be avoided. ***R: The Ponce De León Avenue bridge will be avoided.***

National Marine Fisheries Service (NMFS) - August 20, 1996. Recommended tidal flow enhancement of Caño Martín Peña. ***R: The recommended dredging alternative will enhance tidal flow in Caño Martín Peña. However, this channel and San Jose Lagoon are under a microtidal regime. Wind-driven flow may prove more effective than tidal water movement.***

Puerto Rico Department of Natural and Environmental Resources (DNER) - August 30, 1996. Stated concern for the possible loss of mangrove wetlands due to this project. ***R: Only those mangroves growing in areas that require widening will be removed. The recommended plan calls for replacement of 8 acres with 9 acres of mangroves along the channel. The existing mangrove fringe is not providing many normal functions of this habitat type (production export, juvenile fish habitat, invertebrate habitat) due to poor water quality. One to one replacement is considered more than adequate to replace lost function.***

Puerto Rico Environmental Quality Board (EQB) - November 14, 1996. Stated concerns for the loss of mangrove wetlands that could be caused by this project. It recommended project design to minimize mangrove loss and dredged material disposal so as not to contaminate surface or underground water reservoirs.

The recommended plan would remove only those mangroves that impede widening the channel. The trapezoidal channel would have the same footprint over mangroves as the vertical-walled channel, with a much lower flushing capacity. Since the mangroves are growing over the sediment plug (inside the channel itself) they must be removed.

NMFS - November 7, 1997. Stated concerns for habitat loss and requested an avoidance, minimization, and mitigation sequence. Recommended an EIS be produced.

R: The Corps always attempts to avoid and minimize the effect of its civil works projects over mangroves. However, in the case of Martín Peña, some of the mangrove stands are in the channel itself, and they cannot be saved. For this reason we have recommended creation of 9 acres of mangroves on the land side of the sheet piles that will line the widened channel, with a "lost panel" design to provide tidal flushing.

Municipality of Carolina - November 14, 1997. Opposed dredged material disposal in lands within its jurisdiction. This letter referenced an alternative that would have utilized lands adjacent to Roberto Clemente Sports City in Carolina to create a lined landfill for the dredged materials. ***R: Your opposition to location of a dredged material disposal site within limits of the Municipality is noted.***

USFWS - November 17, 1997. Stated concerns for any spoil disposal in wetlands adjacent to the lagoon system. ***R: The recommended plan would specify disposal of dredged material in the deep holes in San Jose Lagoon.***

Puerto Rico Ports Authority - March 17, 1998. Stated concerns for possible project impacts on the AquaExpreso operation and vehicular traffic in the San Juan metropolitan Area. Requested close coordination during the work cycle to prevent any disruptions. ***R: We are also concerned about logistics associated with construction of the project. Bridge replacements would occur prior to dredging, however, and the Ponce de Leon Avenue Bridge would not be replaced, providing several lanes for traffic between Santurce and Hato Rey. There would be no impacts on the AquaExpreso operation, and access to Ports Authority facilties in Puerto Nuevo and San Juan would likewise not be affected.***

San Juan Bay Estuary Program - June 1, 2000. Stated its concerns regarding possible adverse impacts of dredged material disposal in landfills, and reiterated its preference for using dredged materials to fill deep holes in the San Juan Lagoons, including San Jose. ***R: The recommended disposal alternative was examined at the urging of this Program. It appears that in-lagoon disposal is feasible and cost-effective, and that it should lead to further improvements in flushing and water quality in the coastal lagoons.***

San Juan Bay
Estuary Program

Roberto/Jorge
Esteban Jiménez

June 1, 2000

Mr. José Martínez Laboy
Chief, Planning Section
Antilles Office, Jacksonville District
US Army Corps of Engineers
#400 Fernández Juncos Ave.
San Juan, P.R. 00901-3299

Dear José:

Following are the San Juan Bay Estuary (SJBE) Program Office comments on the Draft Environmental Impact Statement (EA) (May 2000) for the Dredging of the Caño Martín Peña (eastern half). The changes or additions that we recommend to be included in the report are presented in bold and italic.

Page iii. First Paragraph.

"It is an official strategy for overall…in the Estuary's Program's ***Draft*** Comprehensive…"

Page iii. Major Findings and Conclusions.

"This habitat would be replaced on site…" should read " would be replaced ***and enhanced*** on site under the recommended alternative"

"Disposal of dredged material…reaerated by the wind, an***t*** its water quality…" should read "…wind, an***d*** its water quality…"

It is recommended that the EA includes the following information just before the last sentence:

Although not under the scope of the proposed alternative, the connection of those structures that will remain along the CMP to the sanitary sewer system and that needs to be constructed previous to the dredging works, will eliminate raw sewage and other nutrient loadings into the channel. The widening and realignment of those streets adjacent to the CMP will allow municipal authorities to extend the waste collection service into some areas of the communities where at the present time garbage trucks can not entered, encouraging residents to dispose of their refuse correctly and not into the channel.

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Tel. (787) 725-8162

Page 2. 1.3 Project Need and Opportunity. First Paragraph.

"Urban runoff, accidental sewer overflow and discharges form sewer bypasses reach the channel..." could read "Urban runoff, accidental sewer overflow*s and direct untreated sewage discharges* reach the channel..."

Page 6. 2.1 Description of Alternatives. 2.1.2 Alternative 2: Rectangular, 10 Foot Deep Channel.

An explanation as to why no gaps will be left in the new bulkhead between stations 62+00 and 87+00 should be provided.

Page 7. 2.1.6 Disposal Alternative 3: Disposal in Deep Holes in San Juan Lagoons.

It is stated that an estimated 5 percent of the excavated material, consisting of floating materials and debris not suitable for in-bay disposal, would have to be trucked and disposed into a landfill. Although it may not be necessary to state in the report at which landfill this material will be deposited as well as the source for the material that would be used to cap the holes, we would like to provide you with the following alternative. Disposing the material at the Humacao Regional Landfill would have several advantages. This landfill would be one of the nearest to the Caño Martín Peña, reducing transportation costs. The closest route to this landfill would be through Road PR-30. On the return trip, trucks could stop at Gurabo, where the material from the Carraízo Lake dredging project was deposited. This material consists of sand and clay, making it adequate for capping the holes at Los Corozos and San José lagoons. If arrangements to take this material could be made, the trip to the Humacao Landfill would then be more cost-effective by taking also advantage of the return trip. This action would also benefit the communities located beside the area where the Carraízo dredged material was deposited, since they strongly opposed that the material be deposited near their homes.

for p. 8

At the present time the Municipality of Caguas is proposing the construction of a waste to energy facility in its premises to service the San Juan region. Although it is still uncertain if this facility will be developed at all, it could be proposed as an alternative to dispose the dredged material from the Caño Martín Peña. Acquiring the dredged material from Gurabo would still be feasible since it would be relatively near from the proposed incinerator.

Page 15. 3. Affected Environment. 3.1 General Environmental Setting. First Paragraph.

It is recommended that the following information be included after the sentence that reads "The first bridge over the channel was built...":

An 1892 map showed the channel as having an approximate width of 80 to 290 feet (Sepúlveda 1988). In 1899, the western half of the channel was described as 30 to 150 feet wide..."

Page 16. 3.2 Vegetation. First Paragraph.

"Up to at least 1912, Caño Martín Peña had a depth...the main connection between San José Lagoon and open water..." should read "Up to at least 1912, ***the western half of*** Caño

Martín Peña had ***a maximum*** depth of …the main connection between San José Lagoon and *the ocean…*"

Page 16. 3.2 Vegetation. Second Paragraph.

"Total wetland vegetation loss in the entire channel from 1936 to 1995 ***(includes wetlands associated with the Puerto Nuevo River)*** was:

Limit + mp

Page 17. 3.4 Fish and Wildlife Resources.

"The commonest birds heard in the mangrove fringe are bananaquits ***(Coereba flaveola)***, but grackles ***(Quiscalus niger)***, yellow warblers ***(Dendroica petechia)***, shiny cowbirds ***(Molothrus bonariensis)*** and common moorhens ***(Gallinula chloropus)*** are also heard and seen in the area."

Page 20. 3.12 Navigation.

The first sentence should read: "***Until 1998,*** the CMP ***was*** navigable by small boats…". The last sentence should be changed into past tense as: "It ***was*** navigable by paddle powered craft..." Please include the following information after the last sentence: ***At the present time navigation is not possible through the CMP due to the accumulated refuse, but especially to the presence of water hyacinths (Eichornia sp.), that have created a mat, which completely covers its waters.***

Page 24. 4.11 Hazardous, Toxic, and Radioactive Waste.

It is stated that "no likely sources of this material were found during soil, water and sediment sampling for this study, in spite of the numerous samples that were analyzed." However, on page 19, under Section 3.7 Water Quality-Hazardous, Toxic and Radioactive Waste, it is stated that tests carried on soil samples in the area showed elevated total lead and mercury concentrations. This finding is similar to that reported by a water and sediment quality study done for the SJBE Program by the USGS on 1995 (Webb and Gómez-Gómez, 1998). The two statements made in the report seem inconsistent. If mercury and lead concentrations found in soil and sediment samples do not merit any special concerns from their handling during dredging and disposal operations, an explanation should be provided in this section of the report.

Page 24. 4.14 Public Safety.

"All public recreation facilities…to prevent ***accidental***." should read "All public recreation…to prevent ***accidents***."

Page 27. 5.2 Endangered Species Act of 1973.

The first and only sentence in this section should read: "In early scoping…no endangered species or ***critical*** habitat was identified ***as been negatively affected*** in ***the*** CMP ***by the proposed alternative***."

Page 29. 5.10 Marine Mammal Protection Act of 1972.

"There are no records of manatees in either Suárez Channel, San José Lagoon, CMP or inner San Juan Bay."

Two manatee sightings have been recently reported in the San Juan Bay Estuary. The first sighting was reported at the Puerto Nuevo River where a manatee was seen during almost all of the month of March 1999, presumably taking advantage of the fresh water supply, since this occurred during the dry season of the year. Another manatee was seen giving birth in the inner part of the San Juan Bay, next to the port area in the Municipality of Guaynabo coastline (besides Molinos de Puerto Rico) during the month of October 1999. Therefore, we recommend that the phrase "inner San Juan Bay" be eliminated from this section of the report.

Page 29. 5.15 Anadromous Fish Conservation Act.

There are no anadromous fish species in the San Juan Bay Estuary and neither in the rest of Puerto Rico, so no fishes of this kind would be affected by the proposed action. We suggest that this be stated in this section.

Page 31. 7.1 Scoping and Draft EIS.

"The project was endorsed by the Draft and final Comprehensive Conservation and Management Plans (1998 and 1999, respectively)..." should read "The project was endorsed by the ***Preliminary Draft*** and the ***Final Draft*** Comprehensive and..."

Finally CMP (Caño Martín Peña) is used through out the report to refer to the whole channel and also to the eastern half where the proposed works would take place. We suggest that ECMP (Eastern Caño Martín Peña) be used when referring only to the eastern half of the channel to distinguish this area from the rest of the water body.

If you have any questions, please do not hesitate to contact me or Mr. Luis Jorge Rivera Herrera, environmental scientist for the SJBE Program at 725-8162, or by e-mail at Luis.J.Rivera@usace.army.mil. Thank you for the opportunity to comment on this important document.

Cordially,

Edna Villanueva

Edna Villanueva
Technical Director

LJRH/ljrh

Bob N ✓

Diego Loinaz & Son, Inc.

Puerto Rico Ports Authority Resident Environmental Consultant & Projects Manager

March 17, 1998

Mr. Dennis R. Duke
Department of the Army
Jacksonville District Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Confidential

Attn.: Mr. Robert Newman
Planning Division
Environmental Branch

Re: Design Memorandum for Channel Improvements for the Environmental Restoration of Caño Martín Peña

Dear Mr. Duke:

This letter is provided in representation of Dr. Herman Sulsona, Executive Director of Puerto Rico Ports Authority, in response to your request for comments regarding the Design Memorandum for channel improvements for the environmental restoration of Caño Martín Peña. The Puerto Rico Ports Authority (PRPA) has reviewed the proposed alternatives in the Design Memorandum and offers the following general comments or concerns:

- All three alternatives will require dredging of the eastern Caño Martín Peña. Strict controls should be in place to minimize the effects of this action on the western end of the Caño Martín Peña and on the Puerto Nuevo Turning Basin. Siltation of these areas resulting from the Martín Peña dredging may necessitate premature maintenance dredging to support Aqua Expresso and commercial shipping operations. A more significant concern may be the resulting potential contamination of the PRPA operating areas and the substantial cost increase from having to address the disposal of contaminated sediments from these sites. Pre- and post-sampling analysis of the PRPA operating areas may be appropriate to adequately assign future liabilities resulting from the proposed action.

- Replacement of the three bridges in Alternatives 1 and 2 will have significant impacts on the traffic situation in the San Juan metropolitan area. Of particular concern is the impact on Port related traffic and operations. This impact should be properly evaluated and the proposed actions should be sequenced accordingly with scheduled traffic improvement measures, such that the adverse impacts are minimized.

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T 787•253 3527 F 787•253 3567
Suite 213, PR Ports Authority, International Airport, San Juan, PR USA 00979

- Dredging operations in the Caño Martín Peña will also have adverse impacts on scheduled operations of the Aqua Expresso Ferry System. Disruptions in the ferry system's operating schedule will most likely be inevitable and any dredging operations should be planned such that minimal disruptions occur.

Thank you for the opportunity to comment on the proposed actions. If you have any questions concerning the issues brought up from our review please contact me at (787) 287-3443.

Sincerely,

Diego F. Loinaz, PE, CEA
PRPA Environmental Consultant & Projects Manager

GOBIERNO MUNICIPAL AUTONOMO DE CAROLINA

ESTADO LIBRE ASOCIADO DE PUERTO RICO
GOBIERNO MUNICIPAL AUTONOMO DE CAROLINA
Oficina del Alcalde

December 17, 1997

Mr. Dennis R. Duke
Acting Chief Planning Division
Environmental Branch
Department of the Army
Jacksonville District Corps of Engineers
P. O. Box 4970
Jacksonville, Florida 32232-0019

Environmental Restoration of Caño Martín Peña
San Juan, Puerto Rico

Dear Mr. Duke:

On November 14, 1997 the Autonomous Municipality of Carolina, sent you a letter expressing our strong opposition for the disposition of dredged material from Caño Martín Peña at a parcel of land near Iturregui Avenue in Carolina.

In that occasion, we suggested and urged you to meet with us in order to exchange ideas regarding the proper location for such disposal site. Despite our invitation to discuss this matter, on December 11 the daily newspaper El Nuevo Día published that Carolina is most probably the chosen site for the disposition of the dredged material.

Please be informed that the Autonomous Municipality of Carolina claims its right to manage its own Territorial Development Plan. A municipal project has already been identified for that area, and the location of this waste in the vicinity will greatly affect our environment.

Cordially,

José E. Aponte
Mayor

ld

CAROLINA
TIERRA DE GIGANTES

CN 078-04495
Rev. 2/91

PUERTO RICO ELECTRIC POWER AUTHORITY

San Juan, Puerto Rico

Cable Address
PREPA

P O Box 364267
San Juan, Puerto Rico 00936-4267

December 9, 1997

Mr. Dennis R. Duke
Acting Chief, Planning Division
Environmental Branch
Department of the Army
Jacksonville District Corps of Engineers
Po Box 4970
Jacksonville, FL 32232-0019

Re: Environmental Restoration of
Caño Martín Peña

Dear Mr. Duke:

Reference is made to your letter dated October 28, 1997, in which our Agency is requested to comment upon the technical assistance from your office to the Department of Natural and Environmental Resources (DNER). Also, it states that an invitation to submit comments to this study was requested in July, 1996.

Regarding this invitation to submit comments, our Agency did not receive it. We have no comments concerning the potential environmental impacts that may be caused by the development of this project.

However, our Agency has determined that this project could affect our power distribution lines and equipment in the area. In order to avoid an interruption in service, we recommend that construction efforts be coordinated with Eng. Rafael Meléndez Santiago, Superintendent of Distribution Engineering, at (787) 772-5483.

Cordially,

por: Francisco E. López

Angel L. Rivera Santana, Director
Planning and Environmental Protection

Alternative 3 would dredge the channel to the depth of the sills currently formed by the bridges, approximately 3.5 feet. The channel top width would be limited to 70 feet. Very little additional information is provided for this alternative.

The alternatives still do not include a precise enough description of the impacts to the natural systems that would be involved in each alternative. Numbers of structures or businesses that would need relocation have been estimated for each alternative, but natural resource impacts are mostly lumped for the three alternatives. The dredge spoil would consist mostly of debris with some muck, and amounts would vary between the alternatives: Alternative 1 would be 550,000 cubic yards, Alternative 2 would be 750,000 cubic yards, and Alternative 3 would be 25,000 cubic yards. The disposal of these spoils has been identified as the major impact since it would involve the creation of a disposal area in wetlands, yet the differences in the disposal problem has not been segregated for the 3 alternatives. The overall disposal spoil area being proposed is an 80 acre herbaceous wetland adjacent to San José Lagoon and near one of its connecting channels on the east side of the lagoon. The area would be diked to a height of 20 feet and lined with an impermeable liner. Even including the footprint needed for the dike, the capacity of this area would exceed the worst case scenario (750,000 cubic yards). In addition to the proposed filling of 80 acres of herbaceous wetland, alternatives 1 or 2 of the project would eliminate approximately 25 acres of mangroves (again these impacts have not been evaluated for each of the alternatives).

The proposed mitigation for these impacts would be the enhancement of an estimated 150 acres of herbaceous wetlands lying between the proposed disposal site and the channel leading into San José Lagoon. The enhancement is not described, but would probably involve clean-up of the area and possibly mangrove planting. The adequacy of this mitigation is highly questionable, particularly considering that some of the alternatives may have another purpose (see below) as their primary benefit.

We are concerned about the relative benefits to the natural resources (increased flushing) weighed against the obvious environmental impacts from these various alternatives. There is not enough information on the relative differences in flushing from the 3 alternatives to make a decision based on natural resource concerns. With the information currently provided, we would have to select Alternative 3 (contingent to better quantifying the potential impacts of this alternative).

We are also very concerned that the project purposes for these three alternatives have not been adequately discussed. Alternative 2, and possibly alternative 1, are consistent with the previously proposed Aqua Express project continuation into San José Lagoon. The bridge replacements proposed involve not only deepening the channel under the bridges, but would elevate the bridges and widen the channel. The channel bulkheading (alternative 1) and channel widening (alternative 2) would provide the major channel improvements needed for the Aqua Express. The possibility of using mitigation funds set aside for the PR-53 highway mitigation for the restoration of Martin Peña channel has been discussed. If an alternative is selected that meets the needs of the Aqua Express, we do not believe that mitigation funds from one transportation project should be used to promote the construction of another transportation project that would involve additional impacts to wetlands and aquatic resources. The mitigation being proposed is minimal, and should only be considered if the primary benefits of the project are for the stated natural resource purpose. If the Aqua Express goals would also be met by the selected alternative, the natural resource benefits would be in question and the mitigation for the project should be adjusted accordingly.

Therefore, before this project goes further or an alternative is selected, we strongly believe that the project purpose(s) should be more completely described, and the potential benefits as directly related to the project purpose, as well as the anticipated impacts on the natural resources, need to be described for each alternative. Thank you for the opportunity to comment on this proposed project.

Sincerely,

James P. Oland
Field Supervisor

bby
cc:
DNER, San Juan
COE, San Juan
EPA, San Juan
EPA, New York
NMFS, Miami
EQB, Scientific Assessment Division
PRPB, San Juan

PD

United States Department of the Interior

TAKE PRIDE IN AMERICA

FISH AND WILDLIFE SERVICE
Caribbean Field Office
P.O. Box 491
Boqueron, Puerto Rico 00622

November 17, 1997

Mr. Dennis R. Duke, Acting Chief
Jacksonville District Planning Division
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Re: Martin Peña channel flushing improvements

Dear Mr. Duke:

The interested agencies of the Department of the Interior have reviewed the information provided by your office on alternatives for the planned improvements to Martin Peña channel. Our comments are issued in accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The information provided describes three alternatives (plus a no-action option) for improvements to the flushing rate of Martin Peña channel. The San Juan Bay Estuary (SJBE) program has identified this channel as one of the more polluted water bodies in the SJBE system, and this channel provides the hydrological connection between the inner portion of San Juan Bay and San José lagoon, two of the major water bodies of this system.

Alternatives 1 and 2 are very similar, having channel depths of 10 feet and top widths ranging from 150 to 230 feet. Both of these alternatives would require the replacement of three highway bridges over the channel, since these bridges currently limit the depth of the channels to about 3.5 feet. The major difference between these two alternatives is that Alternative 2 would include a king pile wall similar to the one currently in place on the portion of the channel that serves the Aqua Express ferry. The proposed king pile wall is briefly discussed, but no mention is made of providing flushing behind the wall with perforated bulkheads as was required in the rest of the channel. These alternatives would also involve straightening some sections of the channel, mostly by widening the curves.

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Oficina del Alcalde

GOBIERNO MUNICIPAL AUTONOMO DE CAROLINA

November 14, 1997

Mr. Dennis R. Duke
Acting Chief, Planning Division
Environmental Branch
Department of the Army
Jacksonville District Corps of Engineers
P. O. Box 4970
Jacksonville, Florida 32232-0019

Environmental Restoration of Caño Martín Peña
San Juan, Puerto Rico

Dear Mr. Duke:

The Autonomous Municipality of Carolina has evaluated the proposed alternative for the dredging and restoration of Caño Martín Peña located in the Municipality of San Juan.

As you mentioned in your letter dated October 28, 1997 most of the material excavated from Caño Martín Peña would not be suitable for ocean disposal and that all excavated materials must be deposited at a land disposal site created nearby. Part of the proposed disposal site, located within the Municipality of Carolina, south of Suarez Canal and North of Iturregui Avenue is a track of land owned by the Puerto Rico Land Administration.

The Municipality of Carolina will develop a recreational, ecological and water transportation oriented project in this site. The proposed project is included in our Territorial Development Plan approved by the Planning Board in December of 1992. This Plan is the law instrument that enables the Municipality to plan and develop all its public projects.

We are aware of the necessity of the environmental restoration of Caño Martín Peña. Nevertheless, the proposed use for disposal of excavated material in this prime parcel of land, with a high potential for recreational and ecological development, as well as its proximity to residential areas, goes in detriment of the Territorial Development Plan for Carolina. This disposal of the dredged material in this site is not compatible with said plan nor with the environmental protection public policy.

CAROLINA
TIERRA DE GIGANTES

We strongly oppose to the disposal of the dredged material in this site and invite you to consider other possibilities. Although our opposition, we are most willing to meet with you to discuss other options.

I am sure you are aware this site is composed mostly of wetlands with significant ecological value.

Cordially,

José E. Aponte
Mayor

ld

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, Florida 33702

November 7, 1997

U.S. ARMY
CORPS OF ENGINEERS
ANTILLES OFFICE
REGULATORY SECTION
97 NOV 14 PM 2:38

Colonel Joe R. Miller
District Engineer, Jacksonville District
Department of the Army, Corps of Engineers
Planning Division, Environmental Branch
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Colonel Miller:

The National Marine Fisheries Service (NMFS) has reviewed the request dated June 18, 1997, for information to help define issues and concerns regarding channel improvements to the eastern half of Caño de Martín Peña. The Corps of Engineers (COE) is requesting specific information about use of jurisdictional wetlands for the placement of dredged material. The proposed dredged material disposal site is located south of Suarez Canal and north of Iturregui Avenue within the Municipality of Carolina, Puerto Rico. Further information is necessary to fully address the proposed project and mitigation; however, based on the information provided, we do have the following comments.

Three dredging alternatives are identified to restore the Caño de Martín Peña. Each alternative requires the removal of considerable material from the channel which is mostly comprised of debris and household garbage. Alternative 1 will require disposal of 550,000 cubic yards of dredged material, Alternative 2 will require 750,000 cubic yards, and Alternative 3 will require disposal of 25,000 cubic yards. All of these amounts are too great for local landfills to accommodate so the COE proposes an 80-acre wetland site as a disposal area. It is unclear whether 80 acres are needed for all alternatives or just Alternatives 1 and 2 because they generate so much more dredged material. If Alternative 3 requires less area for de-watering and disposal, it should be considered more favorably. Also, Alternatives 1 and 2 will require the dredging of 20-25 acres of mangroves.

The COE should address the project through the avoidance, minimization and mitigation sequencing required of Sections 10/404 projects to evaluate the various alternatives as they relate to wetland losses. With the information provided, we believe that Alternatives 1 and 2 should be rejected because they would result in the loss 20-25 acres of tidal mangrove habitat from dredging and 80 acres of herbaceous wetlands from dredged material disposal. The San Juan Bay ecosystem has already experienced a great loss of mangrove habitat from industrial and port development and the opportunities for habitat creation is severely limited. Also, the loss of herbaceous wetlands at the dredged material disposal site appears to be directly proportional to the volume of material dredged in the Caño de Martín Peña restoration project. Any alternative that reduces the dredging volume should also reduce the disposal impacts. The COE has indicated that an additional 150 acres of herbaceous wetlands exists immediately north of the proposed disposal site and could be enhanced to offset the loss of herbaceous wetlands from filling and the loss of mangrove habitat from dredging. Further information is necessary to fully assess the merits of the mitigation; however, the NMFS cannot think of any enhancement means that could adequately offset the loss of up to 105 acres of wetlands.

Also, the loss or degradation of these wetlands can lead to subsequent reductions in associated fishery resources that may include such recreationally and commercially important species as common snook (Centropomis undecimalis), sword spine snook (Centropomis ensiferus), mullet (Mugil spp.), snapper (Lutjanus spp.), blue crab (Callinectes sapidus) spiny lobster (Panulirus argus) and shrimp (Penaeus spp.). Executive Order 11990 dated May 24, 1977, regarding wetlands and Executive Order 12962 dated June 7, 1995, regarding recreational fisheries should be addressed for this project by the COE.

The NMFS considers this project to be significant because of the primary, secondary, and cumulative impacts and recommends that the COE prepare an environmental impact statement, in accord with the National Environmental Policy Act, to fully address the issues. We appreciate the opportunity to provide comments on this project. If you have questions, please contact Mr. John Iliff of our Panama City Office in Miami at 305/595-8352.

Sincerely,

W. Mark Thompson for

Andreas Mager, Jr.
Assistant Regional Administrator
Habitat Conservation Division

cc:
F/SER4
F/SER43-MIAMI

COMMONWEALTH OF PUERTO RICO / OFFICE OF THE GOVERNOR

Environmental
Quality Board

AG-AFR-idn

14 NOV 1996

Mr. A. J. Salem
Chief, Planning Division
US Army Corps of Engineers
Jacksonville District
P. O. Box 4970
Jacksonville, FL 32232-0019

Re: Channel Improvements to the Eastern Half of Caño Martín Peña San Juan, Puerto Rico

Dear Mr. Salem:

Recently we have received copy of your letter dated on July 23, 1996, in which you request comments regarding the channel improvements to the eastern half of Caño Martín Peña, San Juan, Puerto Rico project.

After reviewing the submitted documents we have the following comments:

1- An Environmental Assessment or an Environmental Impact Statement of the project shall be submitted, as required by Article 4 (c) of Law No. 9 of June 18, 1970, as amended, to the Scientific Assessment Area of this Board in order to provide us all pertinent information and discussion of the possible impacts of the selected alternative on the environment, for the correspoding evaluation.

   We wish to inform you that compliance with Article 4 (c) of Law No. 9 is a requirement for the issuance of any permit or certification of this Board.

2- It shall be performed a detailed engineering study to demonstrate that the proposed project will improve the water quality of the Caño Martín Peña.

3- The impacts of the selected alternative in mangrove areas shall be minimized in order to maintain the ecological system of the site.

4- The dredged material generated during the project shall be analyzed and all constituents be identified as required by "Resources Conservation and Recovery Act" (RCRA) and by "Toxic Substance Control Act" (TSCA). All appropiate federal and state permits shall be obtain prior to the final disposal of such dredged material. The dredged material shall be disposed properly in such manner that water pollution or other adverse effects to surface waters or to underground waters do not occur.

5- An educational program shall be included as part of the project to orientate the communities near the site to eliminate the disposal of garbage and wastewater into the Caño Martín Peña, in order to improve and maintain the water quality and the aesthetic of the site.

Thank you for the opportunity to comment on this matter. If you have any question, please contact Ms. Lucinia Ghigliotty, Director of the Water Quality Area at (787) 767-8181 ext. 2601.

Cordially,

Héctor Russe Martínez
Chairman

c: Eng. Jorge M. Tous, COE
Mr. José Dávila-Caballero

United States
Department of
Agriculture

Natural
Resources
Conservation
Service

Caribbean Area
PO Box 364868
San Juan, Puerto Rico
00936-4868

October 3, 1996

Mr. A. J. Salem, Chief
Planning Division
Department of the Army
Jacksonville District Corps of Engineers
PO Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Salem:

Re: Channel Improvements to the eastern half of Caño Martín Peña, San Juan, Puerto Rico

At this time we have no comments in regards to the above mentioned project.

Cordially,

Carmen L. Santiago

CARMEN L. SANTIAGO
Soil Scientist Liaison

Gobierno de Puerto Rico
autoridad de acueductos y alcantarillados

September 6, 1996

Mr. A.J. Salem
Chief, Planning Division
Environmental Branch
Department of the Army
Jacksonville District of Corps of Engineers
PO Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Salem:

We acknowledge receipt your July 23, 1996, letter regarding the Martín Peña Channel improvement project. We understand that your Agency is working in the project with the support of the Commonwealth of Puerto Rico and the San Juan Bay Estuary Program. As you may know, the Puerto Rico Aqueduct and Sewer Authority(PRASA) is an active member of the San Juan Bay Estuary Program Committee. Our participation is due to the fact that the area along Martín Peña Channel is one deprived of a sanitary sewer system. Therefore, PRASA agreed with the Environmental Protection Agency(EPA) to include in the Capital Improvement Program a Sanitary Sewer Rehabilitation System for the Martín Peña sector.

The purpose of this project is to enhance the environmental condition of the Estuary and to provide a safe disposition of the residential, commercial or any industrial waste water along the Channel. EPA and our Agency agreed to assign funds for this sanitary sewer system from the State Revolving Fund for the 1995 FY. However, PRASA is still studying the scope of this project which has a preliminary cost amount of 6.0 (six) million.

PRASA has also identified other projects that will improve the water quality in the Channel. Those projects, which include among others the construction of a sanitary sewer from the Hato Rey area to the San José Sanitary Trunk Sewer, will have an estimated cost of $25 million which are not included in our Capital Improvement Program. Because of the need of all these projects for the enviromental improvement of the area and the high investment

Ave. Barbosa 604, Hato Rey, PR 00917 • PO Box 7066, San Juan, PR 00916-9990

involved in its planning, design and construction, it is very important that PRASA should be included in the Martín Peña Channel improvement project rehabilitation planning.

As a member of the San Juan Bay Estuary Program Committee we will continue to contribute to the rehabilitation planning. If you need further information, please contact Eng. Wilfredo Freytes, who is PRASA representative person for this matter, at 756-2525. In this way the Corps of Engineers and PRASA will accomplish its objectives successfully.

Cordially,

Benedicto Colón Otero
Director
Planning and Design Area

COMMONWEALTH OF PUERTO RICO
DA GRICULTURE

P.O. Box 10163
Santurce, Puerto Rico 00908

August 30, 1996

Mr. A. J. Salem, Chief
Planning Division
Department of the ARMY
Jacksonville District Corps of Engineers
PO Box 4970
Jacksonville, Fl. 32232-0019

Dear Mr. Salem:

Re : 96-79-090-ARMY
Caño Martin Peña East End Improvements
San Juan, Puerto Rico

On July 23, 1996, we received your letter in which you requested our commments about Caño Martín Peña East End Improvements.

After one of our technicians studied and analysed the documents enclosed with your letter, we found that the purpose of this project will be deepening the channel to improve water circulation between San José Lagoon and the Southeastern part of San Juan Bay.

Considering that this project will not affect productive agricultural land, and that this project is an important factor for the development of San Juan, our Department has no objection.

Sincerely yours,

Ramón Vargas Alicea

Agro. Ramón Vargas Alicea
Special Assistant to the
Secretary of Agriculture
Land Preservation Office

BE/edg

GOVERNMENT OF PUERTO RICO
PUERTO RICO INDUSTRIAL DEVELOPMENT COMPANY

355 Ave. F. D. Roosevelt
San Juan, Puerto Rico 00918

Telephone (809) 758-4747
Fax (809) 250-1599

August 23, 1996

Mr. A.J. Salem
Chief, Planning Division
Environmental Branch
Department of the Army
Jacksonville District Corps.
of Engineers
PO Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Salem:

RE: CAÑO MARTIN PEÑA EAST END IMPROVEMENTS

Reference is made to your notice of July 23, requesting our comments about the above mentioned project.

At this moment, the Puerto Rico Industrial Development Company have not identified any problem with the future channel improvements that could affect our industrial parks, nor our program.

Cordially,

Ramón Sanabria Berríos

Ramón Sanabria Berríos
Vice President for Development

PO Box 362350, San Juan, Puerto Rico 00936-2350

COMMONWEALTH OF PUERTO RICO
DEPARTMENT OF NATURAL AND ENVIRONMENTAL RESOURCES
DNER

DEPARTMENT OF NATURAL AND ENVIRONMENTAL RESOURCES

August 30, 1996

Mr. A. J. Salem, Chief,
Planning Division
Environmental Branch
Department of the Army
Jacksonville District
Corp of Engineers
PO Box 4970
Jacksonville FL 32232-0019

Dear Mr. Salem:

This is in response to your request for comments of the proposed ***channel improvements to the eastern section of the Caño Martín Peña,*** *San Juan, Puerto Rico.*

The proposed restoration work to be designed by the Army Corps of Engineers, has been requested by the Department of Natural and Environmental Resources (DNER), and funded by the Puerto Rico Legislature. This project has three basic objectives:

1. ***Contribute to SJBES Water Quality Improvement***
2. ***Contribute to the Integrated Development of the Cantera Peninsula***
3. ***Improve the Navigation Possibilities of the Channel***

The proposed activities presented in your circular letter of July 23, 1996, indicate that increasing width and depth is required and the attached map shows that one of the Caño's meanders may have to be removed.

While we agree that environmental quality restoration and channel improvement are required, our Bureau technicians and scientists feel that meander removal may not be necessary and that other alternatives should be explored. This alternative would result in the net loss of wetland (mangroves) and would increase the need for land acquisition and family relocation as well as the cost of the project implementation.

As part of DNER, we will be consulted in the process of this project alternative selection. In order to make the best informed decision as to what alternative to support, we are interested in evaluating further findings from your modelling process. One important result of this modelling process is the estimate flushing increase associated to the different alternatives evaluated, since water quality restoration and not navigation is the main objective of the design.

We are also interested in technical facts that would justify sacrificing valuable habitat and increase project implementation costs. Finally, we recommend that water be allowed to flow into remaining mangrove areas. This strategy has been proven effective in the western section of the channel (Agua-guagua).

Sincerely,

Walter Padilla Peña
Director, Bureau of
Coasts, Reserves and
Wildlife Refuges

oiv

COMMONWEALTH OF PUERTO RICO
OFFICE OF THE GOVERNOR
PUERTO RICO PLANNING BOARD

Minillas Governmental Center, North Bldg.
De Diego Ave, Stop 22
P. O. Box 41119, San Juan, P. R. 00940 - 1119

August 29, 1996

Mr. A.J. Salem
Chief, Planning Division
Department of the Army
Jacksonville District
Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Attention: Planning Division
Environmental Branch

Dear Mr. Salem:

This is in reply to your request of comments on the proposed improvements to the eastern half of Caño Martín Peña in San Juan, Puerto Rico.

According with the proposal, the improvements consists of the deepening of the channel up to the capacity of existing bridge foundations. Several alternatives will be evaluated and it is expected to improve water circulation between the San José Lagoon and the southeastern part of San Juan Bay.

The existing problems in the Martín Peña channel represents a serious obstacle on the development of the southern part of Santurce and the northern part of Hato Rey. This study and the improvements in the channel will bring an opportunity to enhance the adjacent lands of those sectors to the channel. As an example, Peninsula de Cantera whose Plan of Development was approved by the Governor of Puerto Rico on August 8, 1995. The dredging and rehabilitation of the channel constitutes one of the main activities to develop the sector. As part of that Plan, the Planning Board recommended a right of way of forty (40) meters measured from the center line of the channel in order to allow navigability conditions and to bring continuity to Parque Lineal.

We recommend to include, as part of the alternatives to be considered, an evaluation for the channel navigability without the replacement of the existing bridges. The navigability of the channel is of special interest because of the possibility of integrating it to the second phase of Tren Urbano in Santurce. A study on the feasibility of the development and operations of the second phase of the Agua Guagua ferry system project was made on May 1990 by Gautier & de Torres. One of the possible alternatives appears to be the excavation of a new channel to eliminate the existing meander located approximately 300 meters upstream of Ponce de León Avenue bridge. We believe that this alternative does not increase the water flushing effect due to the control of the coastal surge flood elevation. Also this alternative will have several socio-economic problems in its implementation.

The proposed study and improvements to Martín Peña channel should include a detail evaluation of each alternative in terms of its impact on the existing ecological system, the social and economic impact, maintenance costs and the selected site to deposit the dredged material.

Cordially,

Jose R. Caballero

José R. Caballero
Acting Chairman

BB/ET/mla

ADMINISTRACIÓN DE REGLAMENTOS Y PERMISOS

August 26, 1996

Department of the Army
Jacksonville District Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Attention:
Planning Division
Environmental Branch

Dear Sirs:

We appreciate your sending us copy of the notice regarding U.S. Army Corps of Engineers improvements to the east portion of **Martin Peña Channel, San Juan, P.R.**

We remain attentive to further developments regarding this project.

We will also appreciate that your mailing list be updated to indicate that **Mr. Ramón A. Maíz is our Administrator.**

Yours Truly,

Irving Aguayo Segarra
Director
Technical Revision Area

IA/cl

Centro Gubernamental Minillas, Edif. Norte, Santurce, P.R.
PO Box 41179, San Juan, P.R. 00940-1179
Tel: 721-8282

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2
290 BROADWAY
NEW YORK, NY 10007-1866

AUG 22 1996

Mr. A. J. Salem, Chief
Planning Division
U.S. Army Corps of Engineers
Jacksonville District
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Salem:

The Environmental Protection Agency (EPA) has reviewed the scoping document for the channel improvements to the eastern half of Caño de Martín Peña, San Juan, Puerto Rico.

Unfortunately, the lack of detailed information in the scoping document makes it difficult to provide specific comments on the scope of the proposed project. Nevertheless, we recommend that each project's environmental documentation include the following information.

- A discussion of the purpose and need for the proposed project.

- An evaluation of alternatives to the proposed project, including reasonable alternatives not within the jurisdiction of the lead agency.

- A comprehensive evaluation of cumulative, indirect, and secondary impacts. The cumulative impacts analysis should consider the environmental impacts of the project as a whole, and, if any, as one of a number of the other proposed and/or approved projects in the area. The indirect and secondary impacts analysis should address the potential for unplanned growth and subsequent development in the project area.

- The aquatic and terrestrial environments to be impacted by each alternative should be described. These descriptions should include appropriate air quality data, water quality data (ground and surface), sediment quality data, the identification and delineation of all wetlands/mangroves, the identification of floodplains and cultural resources, and the identification of other significant environmental resources in the project area. Particular attention should be paid to potential impacts on mangroves, sea grass, coral reefs, endangered species, and cultural resources in the project area.

- An evaluation of the potential environmental impacts associated with the proposed project. This should include: analyses of impacts to wetlands, ground water, air and water quality, noise, endangered species, floodplains, coastal zones, cultural resources, and other significant aspects of the man-made environment. If the environmental document determines that adverse impacts to environmental resources are unavoidable, measures to mitigate these impacts must be developed and discussed in the document. More importantly, the document should be used to determine whether preparation of an environmental impact statement is necessary.

- A discussion of all potential permits, including Section 10 and/or Section 404 permits from the U.S. Army Corps of Engineers, that may be required for this project.

Thank you for the opportunity to comment. If you have any questions concerning this letter, please contact Marie Jenet of my staff at (212) 637-3747.

Sincerely yours,

Edward J Lenz for

Robert W. Hargrove, Chief
Strategic Planning and Multi-Media Programs Branch

CN 078-C4495
Rev. 2/91

PUERTO RICO ELECTRIC POWER AUTHORITY

San Juan, Puerto Rico

Cable Address
PREPA

P O Box 364267
San Juan, Puerto Rico 00936-4267

August 21, 1996

Mr. A.J. Salem
Chief Planning Division
Environmental Branch
Department of the Army
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Salem:

Re: Caño de Martín Peña
East End Improvements
San Juan, Puerto Rico

We have no issues of environmental significance to comment upon at this time. However, we have an interest in commenting on the Environmental Impact Statement for this project. We would appreciate to receive a copy of this document when it is completed.

We recommend that any issue related to electric power lines or PREPA equipment located in the area, be coordinated with our Engineering Distribution Superintendent, Eng. Rafael Meléndez at (787) 289-3062. If you have any questions on this matter, please contact Eng. Francisco E. López, Head of Environmental Protection and Quality Assurance Division, at (787) 289-4960.

Cordially,

Angel L. Rivera Santana

Angel L. Rivera Santana
Director, Planning and
Environmental Protection

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, Florida 33702

August 20, 1996

Colonel Terry Rice
District Engineer, Jacksonville District
Department of the Army, Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Colonel Rice:

The National Marine Fisheries Service (NMFS) has reviewed the request for information to help define issues and concerns related to channel improvements to the eastern half of Caño de Martín Peña dated July 23, 1996, with comments due August 22, 1996. The canal is located between San Jose Lagoon and San Juan Bay, San Juan Puerto Rico. The purpose of the project is to improve water circulation between San Jose Lagoon and San Juan Bay.

In general, NMFS supports the purpose of the project, as improved water circulation and water quality is likely to promote better fishery utilization of both waterbodies affected by the project. We also support the beneficial use of any clean dredged material generated by the project for habitat restoration or creation projects in San Juan Bay. Our support for this project, however, is coupled with concerns for preserving the existing habitat occurring within the eastern half of Caño de Martín Peña.

The goals of the channel improvement project should emphasize water circulation and water quality. If the project emphasis shifts towards navigability and transportation, the Corps should consider the many associated secondary impacts such as erosion from boat wakes, increased pollution from combustion engines, etc. Secondary impacts from a navigable waterway may offset any gains made towards water circulation and water quality.

During alternative development, the Corps should be particularly aware of the cumulative loss of tidal mangrove habitat that has occurred over the years in the San Juan Bay Estuary. Any realignment of the channel that further eliminates tidal mangrove habitat should be avoided. Likewise, any alignment requiring shoreline hardening to maintain channel depth and slope should be avoided. Each alternative considered should discuss tidal flow through mangrove areas. Tidal flow into existing mangrove areas should not be diminished so as to preclude fishery utilization or detrital export. Instead, tidal flow should be increased or enhanced to maximize nutrient export and provide circulation to mangrove areas that may be currently isolated.

We appreciate the opportunity to provide comments in the early stages of this project. If you have any questions concerning these comments, please contact Mr. John Iliff of our Miami Field Office at 305/595-8352.

Sincerely,

Edwin J Keppner

for Andreas Mager, Jr.
Assistant Regional Director
Habitat Conservation Division

cc:
Mr. A. J. Salem
Chief, Planning Division
Department of the Army, Corps of Engineers
Planing Division, Environmental Branch
P.O. Box 4970
Jacksonville, Florida 32232-0019

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F/SEO23-MIAMI

San Juan Bay Estuary Program

File
San Juan Estuary
Program +
[illegible] DM

August 20, 1996

A.J. Salem
Chief, Planning Division
U.S. Army Corps of Engineers
PO Box 4970
Jacksonville, FL 32232-0019

Dear Mr. Salem:

On June 6, 1996 the Management Committee for the San Juan Bay Estuary Program met to discuss the final scenarios for the Hydrodynamic/Water Quality Mathematical Model being undertaken by the Corps of Engineers - Waterways Experimentation Station (COE-WES).

A brief explanation of the decision making process behind the final selection is as follows:

November 8, 1995: the COE requests that the SJBEP Management Committee submit six scenarios for evaluation in the Hydrodynamic/Water Quality Model.

February 6, 1996: The Management Committee (MC) held a meeting at the EPA with the purpose of defining the six scenarios. The committee developed a list of eleven (11) potential modification/components of the final scenarios and sent written communication of the decision to the COE-WES on February 8, 1996.

February 29, 1996: The COE response to the aforementioned correspondence was a list of six alternatives which in their opinion would best improve the overall quality and productivity of the estuary. The recommendations were submitted to the Model Evaluation Group (MEG) for their expert opinion.

May 1, 1996: The MEG submitted their final recommendations to the MC. It was decided that during the Technical Conference scheduled for May 5-6, 1996, the MEG and the COE-WES representative would meet to discuss the final scenarios and any questions or comments related to them.

400 Fdez. Juncos Ave.,
2nd. Floor,
San Juan, P.R.,
00901-3299
Tel. (809) 725-8162
Fax (809) 725-8164

May 6, 1996: The MEG and COE-WES representatives met and discussed the final six scenarios for the model. A memo was prepared summarizing the discussions the suggested six scenarios for the model.

June 6, 1996: The MC met and discussed the findings of the MEG and voted on the approval of these six scenarios as the ones for running the model. The six scenarios are the following:

1. Deepening and widening of Caño Martín Peña
2. Filling of dredge holes in San José Lagoon
3. Deepen and widen Suárez Canal and the installation of a tide gate
4. Pumping salt water into San José and Los Corozos Lagoons
5. Loading reductions
6. Combination of the above

This is the final decision of the Management Committee and with this information we hope that you have the necessary information for the optimum testing of the program.

If there are any questions, please call.

Cardially,

for Tere Rodriguez
Director

cc: Carl Soderberg, EPA-CFO

NOTE: According to Carl + TERE the benchmark for comparison for all scenarios is the existing conditions

Some of the scenarios may has variations

COMMONWEALTH OF PUERTO RICO

August 20, 1996

Mr. A. J. Salem, Chief
Planning Division
Department of the Army
Jacksonville District Corps of Engineers
PO BOX 4970
Jacksonville, FL 32232-0019

Re: **CAÑO MARTIN PEÑA**
EAST END IMPROVEMENTS.

Dear Mr. Salem:

This is in response to your letter dated July 23, 1996 requesting comments on the proposed improvements of the Martín Peña Canal. It is a fact that the Martín Peña Canal is one of the most polluted areas within the San Juan Bay Estuary and need some cleaning and improvements.

The Puerto Rico Ports Authority has reviewed your request for comments and from our standpoint we endorse this initiative. Our staff is available to meet with your work team to discuss any alternative that may impact the Acuaexpreso Ferry Service, or to provide any available information which you may consider relevant to your study.

Should you need any information please call Eng. José R. Agosto, Assistant Executive Director for Planning and Development at (787)729-8701.

Cordially,

Herman Sulsona
Executive Director

OFFICE OF THE GOVERNOR
LA FORTALEZA

Control 96-3114

August 19, 1996

Mr. A. J. Salem
Chief, Planning Division
Jacksonville District Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

SHPO 08-02-96-02 MARTIN PEñA CANAL, EAST END IMPROVEMENTS, SAN JUAN, PUERTO RICO

Dear mister Salem:

Reference your letter of July 23, 1996 concerning proposed improvements to the Caño Martín Peña. A review of our files indicate that three bridges are located within the project area. Of these, the Martín Peña bridge, located on the west end of the project, is eligible for inclusion in the National Register of Historic Places. The eligibility of the other two bridges is unknown and needs to be assessed, as well as the potential effects the project may have on these or any other structures within the area of the project.

If you have any questions, do not hesitate to contact Ms. Gloria M. Ortiz, State Architect, in our Office.

Sincerely,

Lilliane D. López

Lilliane D. López, Arch.
State Historic Preservation Officer

LDL/MB

c Mr. Edwin Muñiz
USACOE, Antilles Office

STATE HISTORIC PRESERVATION OFFICE
SAN JOSE ST. # 109 / BOX 82 / OLD SAN JUAN, PUERTO RICO 00901 / TELEPHONE 721-3737 / FAX 723-0957

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Caribbean Field Office
P.O. Box 491
Boqueron, Puerto Rico 00622

TAKE PRIDE IN AMERICA

August 6, 1996

Mr. A.J. Salem
Chief, Planning Division
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232

Re: Caño Martín Peña

Dear Mr. Salem:

This is in reply to your request for comments on the proposed channel improvements for the eastern half of Caño Martín Peña. Caño Martín Peña is Metropolitan San Juan's major waterway and also serves as an important wildlife corridor. In the past, there have been various proposals to "restore" the channel. In order to determine the magnitude of impact and type of "restoration" effort that will be made, a determination needs to be made regarding the purpose or purposes to be accomplished. For example, if the channel will serve as a continuation of the Agua-Expreso project design and impacts will vary greatly from those resulting from a simple project to remove sediment buildup in the existing channel. These are two very different purposes and they vary greatly in their impacts.

For a navigation channel most of the existing mangrove fringe and would be eliminated through channel widening. Because of the instability of the sediments, a vertical "H" pile bulkhead would probably be needed as has been constructed along the western half of Caño Martín Peña. A new channel as proposed in the alternatives would eliminate a major stream bend. There would be a potential to restore this area to a natural mangrove channel if all the unauthorized structures were removed.

If the purpose of the project is only to improve flushing and water quality without a major navigation component, then major channel improvements are not needed. The removal of sediments, houses, fill and debris from the channel along with the replanting of mangrove wetlands along the restored banks should suffice. With the removal of sediment banks, navigation is also improved and the area could be used for canoes, kayaks, and small boats. However, this would not meet the needs of the Agua-Expreso.

The disposal of dredge material into the large underwater sand extraction pits formed in the eastern portion San Jose Lagoon could be beneficial if the material is suitable. It would eliminate these anoxic holes and re-establish the lagoon's natural bathymetry. The creation of dredge spoil islands in the lagoon should also be explored as an alternative use for any suitable materials.

Any attempts at restoration should include the removal of all structures and fill in the channel as well as the restoration of bank vegetation.

The Federally listed brown pelican and yellow-shouldered blackbird have been reported from the area. Surveys should be conducted to determine the use of the area by these species.

The removal of shoreline mangrove vegetation may impact roosting areas of brown pelican, along the Caño Martín Peña. Consultation under Section 7 of the Endangered Species Act should be initiated once a final alternative is selected.

We hope that these comments aid you in your planning process, if you have any questions, please contact Felix Lopez of my staff.

Sincerely,

James P. Oland
Field Supervisor

fhl
cc:
DNR, San Juan
COE, San Juan
EPA, San Juan
NMFS, Miami
EQB, Terrestrial Ecology Division
ARPE, San Juan
PRPB, San Juan
IITF, San Juan

ADMINISTRACION DE TERRENOS
ESTADO LIBRE ASOCIADO DE PUERTO RICO

6 AGO. 1996

A.J. Salem
Chief, Planning Division
Department of the Army
Jacksonville District Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Salem:

RE: CAÑO DE MARTIN PEÑA EAST END IMPROVEMENTS, SAN JUAN, PUERTO RICO

On July 23, 1996 we received copy of the above mentioned document for commentaries.

In view of the technical aspects presented by this document, we have no commentaries on the matter.

With nothing further, I remain,

Sincerely

José E. Figueroa González
Executive Director

"Por una mejor calidad de vida, ¡ Unete en la lucha contra el Crimen! "

ave. fernández juncos #52, san juan, p.r. / p.o. box 363767, san juan, p.r. 00936-3767 - tel. 723-8181 / fax 725-4004

From: Bob Newman on 8-9-96

DNER

DEPARTMENT OF NATURAL AND ENVIROMENTAL RESOURCES

August 1, 1996

Mr. Richard E. Bonner
Deputy District Engineer for
Project Management
Jacksonville District
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 322232-0019

Dear Mr. Bonner:

The purpose of this letter is to clarify some questions that were raised during our recent meeting with Mr. Bob Newman and Mr. José A. Martínez of your staff on the status of the Design Memorandum for the dredging of Caño Martín Peña, which we commissioned you to prepare.

As established in the Memorandum of Agreement (MOA), the main purpose of this project is environmental enhancement and improvement of quality of life of people residing along the margins of the channel. Aquatic transportation and urban redevelopment are secondary purposes. To that effect, during our inital meeeting with Secretary Gelabert and Secretary Pesquera, we requested that the design be consistent with the existing "Aguaexpreso" project (depth, width, earth trapezoidal or rectangular with sheet piles, etc.), but without replacing bridges as part of the dredging project. Proposed dredging at bridges should not include their replacement or significant (costly) modifictions. Limitations of existing information about these bridges will probably require that the geotechnical surveys include some borings to establish the structural conditions of the bridges in order to be able to determine how deep and wide the channel can be under the bridges without undermining their function. Preliminary cost of bridge replacement, however, should be prepared as a separate item for future consideration. Alignment of the channel should respect, to the extent possible, approved land use plans for the entire area, particularly the Cantera Península.

One of the alternatives that the San Juan Bay Estuary Program has requested the Waterways Experimental Station (WES) to analyze (from the hydraulic and water quality points of view) is the dredging of the canal with minor alignment modifications, such as slight straightening of the dog-leg section between Ponce de León and Barbosa Avenues, which may be necessary to accomodate aquatic transportation in the future. Funds

(Also improved conveyance

Muñoz Rivera Ave., Stop 3 1/2, San Juan, P.R. / Box 5887, Pta. de Tierra Station, P. R. 00906 / Tel. (809) 724-8774

for that analysis are included in EPA's San Jan Bay Estuary Program budget. Therefore, I do not see at this moment any need to provide WES with additional funds from the Design Memorandum's budget to do that task.

The nature and scale of the dredging of the Martín Peña Channel require that an EIS rather than a EA be prepared to fully comply with EQB laws and regulations and obtainment of a WQC. Such efforts should also be consistent with NEPA. As part of the impact analysis the environmental document should address the positve or negative effects of flooding resulting from the project along the margins of the channel. The Design Memorandum, however, does not need to go into a detailed hydrology and hydraulic analysis of the channel's watershed to assess flooding conditions throughout the entire area with and without the dredging project.

I understand that initial investigations of existing data indicate that there is the possibility of depoisting dredged materials in several deep man-made depressions along the shores of the San José Lagoon, as suggested by Secretary Gelabert. Under this scenario costly bioassays for a Section 103 ocean disposal permit, as contemplated in the MOA, would not be necessary. This will result in savings which can be used to expand on other investigations. Any final savings, however, should be used to prepare plans and specifications for the project.

Sincerely

José A. González Liboy
Administrator
Natural Resources Administration

JAGL/amm

fc: P. Gelabert, DNRA
C. Fowler, COE-SJ
J.A. Martínez, COE-SJ
C. Pesquera, DTOP

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

OCT 28 1997

REPLY TO
ATTENTION OF

Planning Division
Environmental Branch

To Addressees on Enclosed List:

The Department of Natural and Environmental Resources (DNER) requested technical assistance from the Jacksonville District, U.S. Army Corps of Engineers (Corps) under the Support for Others Program for the planning, engineering, design, and environmental assessment of channel improvements for the environmental restoration of Caño Martín Peña (Martín Peña Channel) in San Juan. The Corps will provide a decision document called a Design Memorandum (DM) to Commonwealth cooperators. The scope of design would be limited to the eastern half of Caño Martín Peña. This segment extends from the terminus of the Aqua Express at the Hato Rey intermodal passenger terminal near Luis Muñoz Rivera Avenue bridge to the San José Lagoon.

The Corps study has identified three channel improvement alternatives that would provide varying degrees of flushing to Caño Martín Peña. The DM will evaluate these alternatives in terms of their overall cost and environmental benefits, including lands, easements, rights of way, relocation of structures, relocation of utilities, project construction, disposal of dredged materials, project operation and maintenance, as well as their tidal flushing capacity and overall environmental value. The alternative selected by DNER would be developed in sufficient detail to proceed with the preparation of detailed plans and specifications for a construction contract. Construction would be funded by the Government of Puerto Rico.

Ongoing investigations confirmed that most of the environmental problems of Caño Martín Peña are a direct result of the insufficient hydraulic capacity in the channel to assimilate and flush out pollutants. The channel capacity has been greatly reduced as a result of siltation, debris accumulation, and structure encroachments. Recent hydrographic and topographic surveys of Caño Martín Peña show that channel width varies from 200 feet to less than 20 feet and depth varies from 3 to 0 feet. Results from the hydraulic modeling of the 100-year hurricane tide at San Juan Bay show very little tidal exchange between San José Lagoon and San Juan Bay under existing conditions. On the other hand, the proposed channel improvements under alternatives 1 and 2 would propagate tidal conditions into San José Lagoon and increase hurricane tide levels by about 2.2 feet.

Alternative 1 consists of a 11,200-foot long trapezoidal earth channel along the existing Caño Martín Peña alignment. At straight and minor bend sections top width would be 150 feet; at major bend sections it would be 230 feet. The channel bottom elevation would be set at minus 10 feet and the side slopes would be set at 1 (vertical) on 5 (horizontal). The channel bottom width would vary between 20 and 95 feet. This alternative would require replacing all three existing highway bridges, which now limit channel depth to 3.5 feet and channel top width to 200 feet. This alternative would require the excavation of about 550,000 cubic yards of mostly debris materials. It would require the relocation of several utilities in the area and the acquisition of 438 structures along the channel alignment.

Alternative 2 consists of a 11,200-foot long channel with vertical concrete sheet pile and earth bottom, known as a king pile wall channel, similar to the existing Aqua Express channel. The channel top width and bottom elevation would be identical to Alternative 1. King piles would be precast concrete pile units with a top elevation of 3.0 feet. They would be driven to an approximate tip elevation of -50 feet. King piles would be spaced at 10 foot centers and would have formed slots to install 6 inch thick, precast concrete panel sections. Batter piles would be installed behind each king pile to the same tip elevation to provide lateral support. A continuous reinforced concrete cap would be placed after piles have been driven and panels installed. If existing highway bridges remain along the channel, this alternative would also require a channel transition near each of three existing highway bridges where the channel invert elevation is limited to minus 3.5 feet and the channel top width is limited to 200 feet. This alternative would require the excavation of about 750,000 cubic yards of mostly debris materials, and would require the relocation of the same bridges and utilities, and the acquisition of the same number of structures as Alternative 1.

Alternative 3 consists of a 11,200-foot long small trapezoidal earth channel along the existing Caño Martín Peña alignment. The channel top width would be limited to 70 feet. The channel invert elevation would be controlled by the elevation of the existing bridge pile caps of about minus 3.5 feet The channel side slopes would be set at 1 on 10. This alternative would require the excavation of about 25,000 cubic yards of mostly trash and debris. It would require the relocation of several utilities in the area and the acquisition of 180 structures along the channel alignment. This alternative would not require replacing existing bridges.

The no-action alternative supposes continued siltation and trash and debris accumulation within the banks of Caño Martín Peña. It might require acceptance of a gradual complete disappearance of Caño Martín Peña, and the continued physical deterioration of the detailed study area.

The material excavated from Caño Martín Peña would require special handling and disposal. A permit would be required from the Corps' Regulatory Division, for the proposed dredging and dredged materials disposal. Recent subsurface explorations along the entire canal indicated a very high concentration of solid residential wastes (garbage and debris) and organic sediments. Most of the material to be excavated from Caño Martín Peña would not be suitable for ocean disposal. Existing landfills located in nearby municipalities (San Juan, Toa Baja, and Carolina) cannot accommodate this quantity of material. Therefore, it is anticipated that all excavated materials must be deposited at a land disposal site to be created nearby. It is estimated that the disposal site would cover about 80 acres of land. The disposed material would be contained by a 20 feet high ring levee with a 10 feet top width, a 50 feet bottom width, and 1 on 1 side slopes. The selected disposal site would be prepared for a one time disposal of material to be excavated from the Martín Peña Channel. This would include soil, organic material, household waste and construction debris. A high density polyethylene (HDPE) barrier would be placed as a liner. Additional treatment and handling techniques would be included as necessary to satisfy permitting requirements.

The proposed 80 acre disposal site (circled by the heavy black line) shown in the enclosed map is located within the Municipality of Carolina, south of Suárez Canal and north of Iturregui Avenue. The entire site is jurisdictional wetlands. An estimated additional 150 acres of herbaceous wetlands (located north of the considered disposal area) are available for enhancement, as mitigation for both the disposal area creation (conversion to uplands) and for mangrove removal caused by channel improvements (estimated to be 20-25 acres under either alternative 1 or alternative 2). In spite of extensive search, no upland site, and no other land site of suitable area or suitable proximity to the dredging site, has been identified.

Replacement of Luis Muñoz Rivera, Ponce De León, and Barbosa Avenue bridges is required to raise lower chord elevations to a minimum of 20 feet, to increase clear distance of center spans to 100 feet, and to lower the elevation of bridge pile caps to less than minus 10.0 feet. Replacement is required for all but Alternative 3. The existing bridges would be removed and new bridges would be constructed over the existing bridge footprint with the same roadway width. Existing approaches would be used but would require an increase in grade to accommodate the higher elevation of the new bridge decks. Reinforced earth retaining walls would be utilized with approaches to minimize real estate acquisition and impact to congested areas.

Interested agencies and individuals were last invited to submit comments to this study in July, 1996. We welcome your views, comments or suggestions and information about natural, cultural and community resources of the proposed disposal and mitigation site, illustrated on the enclosed photo-map composite. Please send your letters to the attention of the Planning Division, Environmental Branch, at the letterhead address within 15 days of the date of this letter. If you are aware of any other person, organization, or agency that may have comments about the proposed site, please share this communication with them.

Sincerely,

Dennis R. Duke

Dennis R. Duke
Acting Chief, Planning Division

Enclosures

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CANO MARTIN PENA DESIGN MEMORANDUM
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PD

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

OCT 27 1995

Programs and Project Management Division
Project Management Branch

COPY

Honorable Pedro Gelabert
Secretary
Department of Natural and Environmental Resources
Post Office Box 5887, Puerto de Tierra
San Juan, Puerto Rico 00906

Dear Mr. Secretary:

This is in response to your letter dated October 3, 1995, (copy enclosed) requesting that the U.S. Army Corps of Engineers prepare a Design Memorandum (DM) for the dredging and environmental restoration of Mártin Peña Canal from Muñoz Rivera Avenue to the San José Lagoon under the Support for Others Program (SFOP).

As indicated in recent meetings between Eng. José González Liboy of your office and Messrs. Bob Newman and José Martinez of my staff, we can perform this work under the SFOP. We have developed a scope of work, schedule, and budget for this DM. The scope generally follows the guidance provided by Eng. Liboy. Basically, the two following preliminary alternatives will be evaluated:

a. An earth trapezoidal channel that provides the conveyance of the original design bridge cross sections; and,

b. An 83-meter wide by 10-foot deep rectangular channel with sheet pile walls and earth channel. This design would transition into and out of the bridges. No bridges would be replaced with this alternative, but a preliminary estimate of costs to replace the bridges will be developed.

Once your agency has selected one of the alternatives, we would prepare the detailed designs and complete the DM. This will include sufficient information to proceed into the preparation of plans and specifications for construction. It should be noted that disposal of dredge material will be a critical issue for both of the alternatives. Should the results of bioassays reveal that offshore disposal is not viable, an acceptable alternative disposal scheme may prove very costly.

Four copies of the Memorandum of Agreement (MOA), including the Scope of Work (SOW) as an enclosure, is provided for your review and approval. Should this document be satisfactory, you may sign and return the four sets of originals to me for execution. The schedule as prepared assumes that funds in the amount of $650,000 will be received by January 11, 1996, with the remaining $330,000 to follow by September 30, 1996. Under this scenario, a final DM would be ready by September 1997. Should a lesser initial amount be received, the schedule would be adjusted accordingly.

Our work as described in the enclosed SOW will be completed when the final DM is submitted to you, the NEPA coordination is finalized, and Water Quality Certification has been requested. Should your agency wish to contract with the Corps to prepare plans and specifications for the final plan developed in the DM, the MOA could be amended accordingly. This would include developing a revised SOW and cost estimate reflecting the additional work requirements.

If you have any questions concerning this information, please do not hesitate to contact me at 904-232-2241 or Mr. Bob Newman who will be the project manager for this work. Our Corps team welcomes the opportunity to work with your agency towards the environmental restoration of the Martín Peña Canal.

Sincerely,

Terry L. Rice
Colonel, U.S. Army
District Engineer

Enclosures

Copies Furnished:

Mr. José González Liboy, Administrator for Natural Resources, Department of Natural and Environmental Resources, Post Office Box 5887, Puerta de Tierra, San Juan, Puerto Rico 00906

Mr. Ramon Alonso Harris, Asst. Secretary for Water and Mineral Resources, Department of Natural and Environmental Resources, Post Office Box 5887, Puerta de Tierra, San Juan, Puerto Rico 00906

DEPARTMENT OF NATURAL AND ENVIRONMENTAL RESOURCES

October 3, 1995

COL Terrence Rice
Commander
U.S. Army Engineer District
Corps of Engineers
400 West Bay Street
Jacksonville, FL 32232

Dear Colonel Rice:

The purpose of this letter is to request you prepare for us, under the authority of Support for Others Program, the design memorandum for the dredging of the Caño Martín Peña from Muñoz Rivera Avenue to its confluence with the San José lagoon.

The requested work should follow the Martín Peña Canal Project Management Plan prepared under Section 22 Planning Assistance to States for the Corporation for the Development of the Cantera Peninsula. Though the main purpose of the dredging at this moment is environmental enhancement and facilitate the area's redevelopment, the Government of Puerto Rico intends to extend in the future the Agua/Guagua service along the entire canal. To that effect, the design should be consistent with that purpose.

There are two important elements of the design that demand particular attention. The first relates to the necessary lands, easements, rights-of-way, and relocations for the implementation of the project together with necessary development of new utilities facilities (sewer) in the area for the project to be effective while the second refers to developing acceptable and viable alternatives for disposal of dredge materials. Also, the design should not contemplate replacing the bridges at this moment.

During the last ten years considerable planning efforts and field data collection have been undertaken by several local and federal agencies for the study area. Some of this information is being updated and expanded through different programs, such as the San Juan Bay Estuary Program and the Environmental Quality Board Water Quality Program. All this information should prove very helpful in the development of the design memorandum.

... de Tierra Station P.R. 00906 / Tél (809) 724-8774

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019
July 23, 1996

REPLY TO
ATTENTION OF
Planning Division
Environmental Branch

TO ADDRESSEES ON THE ENCLOSED LIST:

The Jacksonville District, U.S. Army Corps of Engineers (Corps), is beginning to gather information to help define issues and concerns related to the channel improvements to the eastern half of Caño de Martín Peña, San Juan, Puerto Rico. An enclosure describes and shows the study area and gives additional details. The project is being undertaken in support of the Commonwealth of Puerto Rico and the San Juan Bay Estuary Program. Commonwealth sponsor would be the Puerto Rico Department of Natural and Environmental Resources. We welcome your views, comments or suggestions and information about natural, cultural and community resources, study objectives, and environmental features within the described study area.

Please send your letters to the attention of the Planning Division, Environmental Branch, at the letterhead address within 30 days of the date of this letter. If you are aware of any other person, organization, or agency that may have an interest or comments about this study, please inform us or notify them so they may have an opportunity to comment.

Sincerely,

A. J. Salem

A. J. Salem
Chief, Planning Division

Enclosures

JUL 23 1996

Planning Division
Environmental Branch

TO ADDRESSEES ON THE ENCLOSED LIST:

The Jacksonville District, U.S. Army Corps of Engineers (Corps), is beginning to gather information to help define issues and concerns related to the channel improvements to the eastern half of Caño de Martín Peña, San Juan, Puerto Rico. An enclosure describes and shows the study area and gives additional details. The project is being undertaken in support of the Commonwealth of Puerto Rico and the San Juan Bay Estuary Program. Commonwealth sponsor would be the Puerto Rico Department of Natural and Environmental Resources. We welcome your views, comments or suggestions and information about natural, cultural and community resources, study objectives, and environmental features within the described study area.

Please send your letters to the attention of the Planning Division, Environmental Branch, at the letterhead address within 30 days of the date of this letter. If you are aware of any other person, organization, or agency that may have an interest or comments about this study, please inform us or notify them so they may have an opportunity to comment.

Sincerely,

A. J. Salem
Chief, Planning Division

Enclosures

bcc:
DP-I (Newman)
CO-RS-J (Collazo)
DS-PD (J. Martínez)
DS-RD (E. Muñiz)

Lang/CESAJ-PD-ES/2615/mw
Cintrón/CESAJ-PD 7/17
Kurzbach/CESAJ-PD-ES
Smith/CESAJ-PD-E
Strain
Gonzalez/PD-PB
Salem/CESAJ-PD

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CAÑO DE MARTIN PEÑA EAST END IMPROVEMENTS
U.S. ARMY CORPS OF ENGINEERS SUPPORT FOR OTHERS
SAN JUAN, PUERTO RICO

1.0 <u>Background.</u> Under the Support for Others Program, the Jacksonville District Corps of Engineers (Corps) will design channel improvements for the eastern half of Martín Peña Channel for the Commonwealth of Puerto Rico. Improvements would consist of deepening the channel up to the capacity of existing bridge foundations. Alternative designs will be developed and described. All alternatives are expected to improve water circulation between San José Lagoon and the southeastern part of San Juan Bay. The Puerto Rico Department of Natural and Environmental Resources has requested this work, which will be reported in a Design Memorandum.

2.0 <u>Prior Work, Studies and Reports</u>. The Corps managed the design and dredging of the Martín Peña ferry channel (extending from San Juan Harbor to the east side of the Muñoz Rivera Avenue bridge) during the 1980's. Many studies were done for this project, built in 1987. Additional recent studies have been undertaken by the Corps and others in support of the San Juan Bay Estuary program, the San José Lagoon bridge, and other nearby public works projects. The channel suffers from insufficient hydraulic capacity, siltation, debris accumulation and encroachment of residences into the water on both banks. Siltation is especially severe between Laguna San Jose and the Barbosa Avenue bridge. Water exchange through the eastern end of the channel is nearly blocked, resulting in poor water quality and loss of navigability.

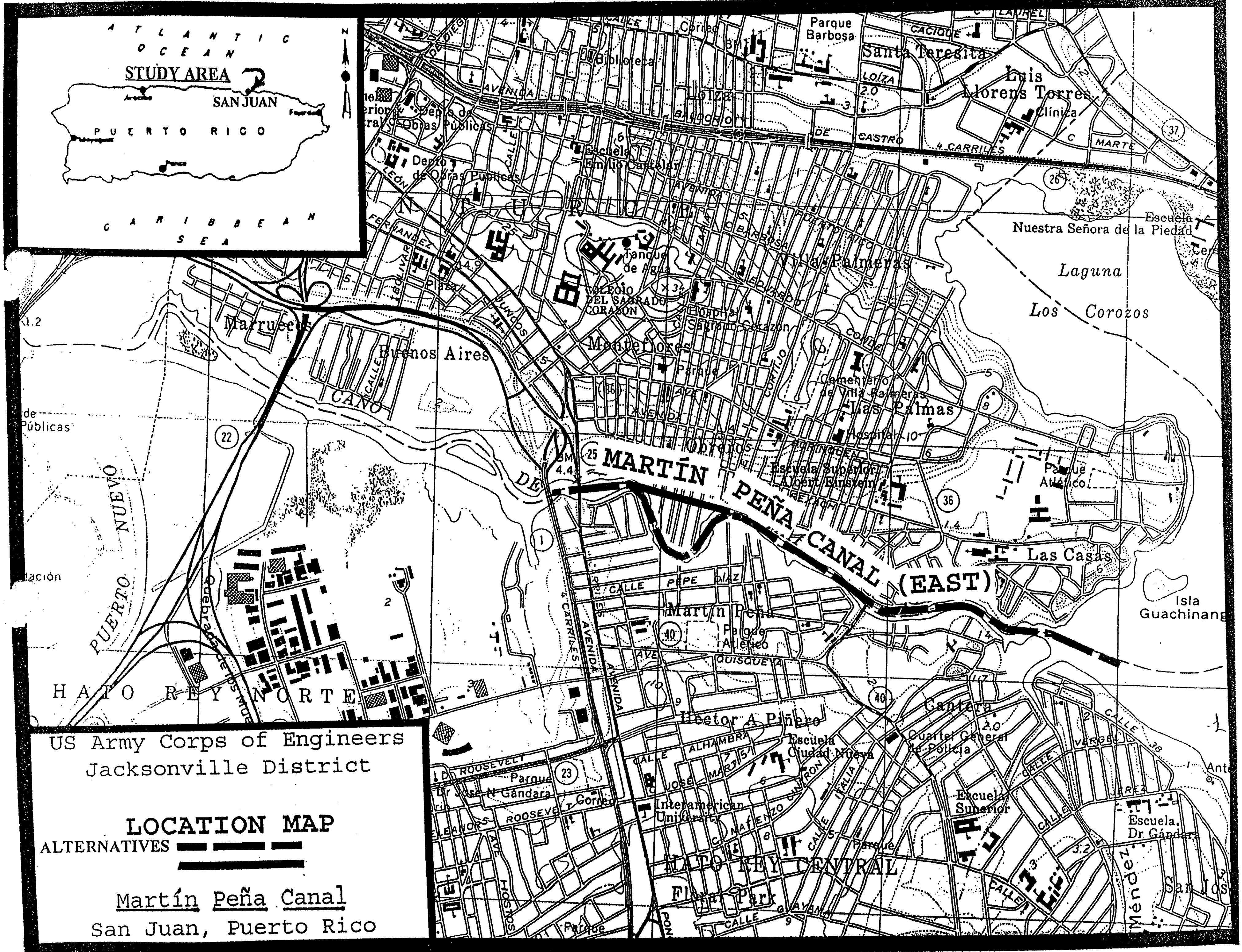
3.0 <u>Location and Project Features</u>. Martín Peña channel is a tidal creek that forms a meandering, generally east-west trending boundary between the San Juan wards of Santurce (on the north) and Hato Rey (on the south). Net tidal flow is very slight in an east-west direction, from San Jose Lagoon towards San Juan Harbor. The channel drains about 2,500 acres. The study area extends from the eastern end of Acua-Expreso at Luis Munoz Rivera Avenue 1.6 miles east to San Jose Lagoon.

4.0 <u>Study.</u> The report will identify channel improvement alternatives and associated costs including real estate acquisition, relocations, construction, operations and maintenance. The Department of Natural Resources (DNER) will then select an alternative for which Plans and Specifications will be prepared.

5.0 Alternative Selection. More than one channel profile will be considered. Structures presently located within the original channel "footprint" that impede water flow will be assumed subject to removal. At least one alternative will be considered to increase navigability and possibly extend ferry service to San José Lagoon. Such a channel would have a maximum 10 foot depth (if permitted by existing bridges), and a width that would depend upon limitations imposed by existing bridges and substrate characteristics. All alternatives to be considered will require excavating a larger channel section along the existing channel alignment. Significant amounts of dredged material will be generated and disposed of under any alternative recommended. Minor alignment changes may also be studied. Removal of existing structures along the channel may be considered for larger channel alternatives. Channel side slopes would be determined based on soil characteristics. Dredged material may be studied for potential disposal in deep existing holes in San José lagoon. An as yet undetermined volume of domestic debris and refuse will require disposal in a landfill. Appropriate dredged material disposal methods will assure that Commonwealth water quality standards are maintained during project implementation.

6.0 Environmental Documentation. The alternative selected will be assessed for compliance with all applicable Commonwealth and Federal environmental statutes including the National Environmental Policy Act (NEPA). A Corps of Engineers permit will be required for the construction work. A Commonwealth Water Quality Certificate and Coastal Zone Consistency Certification will also be required. NEPA documentation will be completed during the Federal permit authorization process. Circulation of this project description and request for comments marks the beginning of the public involvement process under NEPA. Your information and views will assist our staff to evaluate the project area, identify significant natural and cultural resources and other pertinent new issues, opportunities or concerns, and address these issues as necessary.

Enclosure


US Army Corps of Engineers
Jacksonville District
LOCATION MAP
ALTERNATIVES
Martín Peña Canal
San Juan, Puerto Rico
ATLANTIC OCEAN
STUDY AREA
SAN JUAN
PUERTO RICO
CARIBBEAN SEA
MARTÍN PEÑA CANAL (EAST)
Santa Teresita
Luis Llorens Torres
Clínica
Parque Barbosa
Biblioteca
Loíza
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Colegio del Sagrado Corazón
Hospital Sagrado Corazón
Monteflores
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Cementerio de Villa Palmeras
Las Palmas
Hospital
Obreros
Escuela Superior Albert Einstein
Nuestra Señora de la Piedad
Laguna Los Corozos
Parque Atlético
Las Casas
Isla Guachinang
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ROOSEVELT
ALHAMBRA
QUISQUEYA
DE CASTRO
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CONDE
LOIZA
MARTE
CACIQUE
LAUREL
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CAÑO DE MARTÍN PEÑA
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SUMMARY OF RESULTS
SAN JUAN BAY ESTUARY MODEL

I. INTRODUCTION

A study sponsored by the San Juan Bay Estuary Program (SJBEP) developed a hydrodynamic and water quality model of the entire estuary system to evaluate several proposed management strategies. The proposed management strategies were devised to accomplish the maximum possible water quality improvements. The hydrodynamic and water quality models of the San Juan Bay Estuary (SJBE) included four components: (1) bathymetric surveys of the entire estuary; (2) hydrodynamic field data collection; (3) water quality data collection; and (4) hydrodynamic and water quality modeling.

II. HYDRODYNAMIC AND WATER QUALITY MODELS

A three dimensional hydrodynamic numerical model, previously used for the Chesapeake Bay study, and a time-varying, three dimensional, numerical water quality model, were applied to the San Juan Bay Estuary System. The modeling was performed by the U.S. Army Corps of Engineers, Waterways Experiment Station (WES), in Vicksburg Mississippi. Physical processes in the model include tides, wind, density effects, freshwater inflows, turbulence, and the effect of the earth's rotation.

The initial SJBE modeling effort by WES included ten sets of simulations to assess the impact of proposed management strategies on water quality. The initial simulation calibrated the model for existing conditions. Five other scenarios involved some form of bathymetric and/or geometric modification which would result in a redistribution of flows. Two scenarios involved only loading reductions. While the last two scenarios evaluated combinations of the most effective geometric modifications and loading reductions.

The overall strategy for the models consisted of developing a scenario test period (STP) that was used for all scenarios so that comparisons of the relative worth of various proposed management strategies could be evaluated. The calibration period of summer of 1995 was chosen for the STP. The STP extended for one complete lunar month (28.25 days). Each water quality model scenario was run for eight times to spin-up the new conditions, thus achieving a new dynamic steady-state. The results from the final 28.25-day STP are discussed in the following sections.

III. CAÑO MARTÍN PEÑA PDR

Of most interest to the Caño Martín Peña PDR are the four sets of simulations that evaluated the existing conditions baseline scenario, impacts of the Caño Martín Peña dredging scenarios, and impacts of filling the deep holes within San José, Los Corozos, and La Torrecilla lagoons. Both numerical models for the San Juan Bay Estuary evaluated tidal flows and freshwater inflows, and concentrations of chlorophyll, algae, salinity, dissolved oxygen, total phosphorous, total nitrogen, organic carbon, total solids, and fecal coliforms over a 28 day tidal cycle and at three foot depth intervals.

III. MODEL RESULTS

A. Existing Conditions

The existing conditions scenario served as baseline against which all other scenarios were compared to evaluate their effectiveness. Under the existing conditions scenario, model results indicated anoxic bottom water, high concentrations of surface chlorophyll, total nitrogen, total phosphorus, and fecal coliforms along the entire eastern half of Caño Martín Peña and many other areas of SJBE. Many portions of the SJBE system have less than adequate flushing characteristics to assimilate these pollutant loadings.

B. Selected Alternative (Alternatives 1 and 2)

This scenario consisted of a channel widened to a minimum width of 150 feet and deepened to a maximum depth of 9 feet. This scenario was run with all other conditions and configurations set the same as for the base line scenario.

The hydrodynamic impact of the selected alternative widening and deepening of Caño Martín Peña is to increase the average flow from San José Lagoon to Caño Martín Peña from 18 cubic feet per second to 106 cubic feet per second, and to decrease the net flow from San José Lagoon to Canal Suárez from 70 cubic feet per second to 14 cubic feet per second. In effect, a clockwise circulation pattern would be established through the interior of the system from La Torrecilla Lagoon to the entrance of the San Juan Bay.

The model showed a significant increase in the tidal range in San José Lagoon from less than 2 inches up to 14 inches. The tidal flushing between San Juan Bay and San José Lagoon increases by more than an order of magnitude. With the tremendous increase in tidal flushing through Caño Martín Peña, the high saline waters of San Juan Bay move into San José Lagoon, resulting in increases in salinity in Caño Martín Peña, San José Lagoon, and Canal Suárez to approximately 23 parts per thousand.

Chlorophyll levels in the surface layer of Caño Martín Peña, San José Lagoon, and canal Suárez decreased as a result of significant flushing into San Juan Bay. Correspondingly, there were chlorophyll levels increases San Juan Bay. Phytoplankton production levels increased in San Juan Bay as a result of San José Lagoon algae being discharged to San Juan Bay via Caño Martín Peña.

The large widening of Caño Martín Peña resulted in more nitrogen, phosphorus, and carbon leaving San José Lagoon through Caño Martín Peña rather than through Canal Suárez.

Dissolved oxygen levels improved considerably over the length of Caño Martín Peña. Bottom dissolved oxygen levels increased considerably in Caño Martín Peña, Canal Suárez, and La Torrecilla Lagoon.

Fecal coliform levels decreased in Caño Martín Peña by an order of magnitude in part due to additional receiving water volume being present. Levels increased insignificantly in San Juan Bay as a result of additional flushing through Caño Martín Peña. Total solids levels decreased throughout the system with the greatest decreases occurring in Caño Martín Peña.

C. Alternative 3

This scenario consisted of limited clearing the existing channel to less than 70 feet wide and maximum 3 feet deep. This scenario was run with all other conditions and configurations set the same as for the base line scenario.

The hydrodynamic impact of a limited widening and deepening of Caño Martín Peña is to slightly increase the net flow from San José Lagoon to Caño Martín Peña from 18 cubic feet per second to 51 cubic feet per second, and slightly decrease the net flow from San José Lagoon to Canal Suárez from 70 cubic feet per second to 38 cubic feet per second.

The model showed no significant change in the tidal range in San José Lagoon and showed a slight set down in the Lagoon water level. This was due to more of the San José Lagoon freshwater inflow being able to move out of the Lagoon more quickly through the improved Caño Martín Peña. As a result of the increased westward freshwater flow from the San José Lagoon, the salinity in Caño Martín Peña would decrease and the salinity in Canal Suárez and nearby Lagoon areas would increase.

Chlorophyll levels in the surface layer of western Caño Martín Peña increased as a result of additional flushing from San José Lagoon. Correspondingly, there were chlorophyll levels decreases in San José Lagoon. Phytoplankton production decreases in San José Lagoon as a result of lower algae levels due to increased flushing.

The slight widening of Caño Martín Peña resulted in more nitrogen, phosphorus, and carbon leaving San José Lagoon through Caño Martín Peña rather than through Canal Suárez.

Dissolved oxygen levels improved considerably over the length of Caño Martín Peña. The largest increase occurred near the middle of the canal. Bottom dissolved oxygen levels increased slightly in Caño Martín Peña, Canal Suárez, and La Torrecilla Lagoon.

Fecal coliform levels remained unchanged except for a slight decrease at the eastern end of Caño Martín Peña. Total solids levels decreased as a result of additional flushing.

D. Filling Holes in Lagoons

This scenario consisted of filling all deep holes within San José Lagoon, Los Corozos Lagoon, and La Torrecilla Lagoon. This scenario was run with all other conditions and configurations set the same as for the base line scenario.

The hydrodynamic impact of filling the deep holes within San José Lagoon, Los Corozos Lagoon, and La Torrecilla Lagoon is to decreases the salinity in Caño Martín Peña, San José Lagoon, and Canal Suárez. This scenario was unique among other scenarios in that nothing was done which would improve circulation and flushing of San José Lagoon, Caño Martín Peña, or Canal Suárez.

Filling the anoxic deep holes of San José Lagoon and Los Corozos Lagoon would decrease sediment nutrient fluxes and the oxygen demand arising from these holes.

IV. CONCLUSIONS

The major goal to be accomplished through physical changes to the SJBE system is to increase tidal flushing in Caño Martín Peña and San José Lagoon. The results from the various scenarios discussed above shows that significant widening and deepening of Caño Martín Peña accomplishes this goal the best, if the desire is to increase the exchange between San José Lagoon and San Juan bay. The hydrodynamic model demonstrated that with the increased tidal flushing resulting from significant widening and deepening of Caño Martín Peña, along with filling the highly polluted deep holes in San José Lagoon, would offer the best hope for improving the water quality of San José Lagoon.

DREDGING OF CAÑO MARTÍN PEÑA
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APPENDIX B
GEOTECHNICAL INVESTIGATIONS

DETAILED DESIGN MEMORANDUM
MARTIN PENA CANAL
SAN JUAN, PUERTO RICO

APPENDIX B
GEOTECHNICAL

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GEOTECHNICAL

1. **Introduction.** This appendix presents the results of the subsurface explorations, laboratory work and subsequent geotechnical analysis for the proposed Martin Pena Canal, San Juan, Puerto Rico.

The project will serve to provide improved flushing for the San Jose Lagoon (check on this) by widening and deepening the Martin Pena Canal which connects it to San Juan Harbor. The project consists of the deepening and widening of the existing canal to a depth of 10 feet and a width that will vary from approximately 200 to approximately 300 feet and bounding the banks of the channel with a concrete capped sheet-pile wall along most of it's reach. For part of the channel's length, a cantilevered concrete-pile wall will be installed due to the presence of limestone in the subsurface that sheet piling can not be driven through.

2. **Measurement System and Datum.** All elevations are referenced to the National Geodetic Vertical Datum, (NGVD).

3. **Field Exploration and Laboratory Testing.** The field exploration and laboratory testing for this site was carried out in two phases. The first phase, was performed May through September, 1997. The second phase was performed April through June, 1998.

A. Site Description. The Martin Pena Canal is one of several canals in the San Juan area that make up the intercoastal drainage system. The canal extends from the Puerto Nuevo Canal, which connects directly to San Juan Bay, eastward to the San Jose Lagoon.

The western portion of the canal has been developed to serve as a waterway for small craft. The eastern portion of the canal has been significantly impacted by the encroachment of local urban development. The encroachment has occurred due to the disposal of household refuse, concrete and construction debris, automobile parts and furniture and household appliances which was subsequently capped with soil. As these filled areas were established, homes were constructed on them until the canal was gradually choked.

The topography of the area is generally flat with elevations ranging from approximately 2 to 5 feet NGVD. The exception to this topography are the embankments for the three bridges which cross the Martin Pena Canal along the project length. These embankments rise to elevations of 15 to 18 feet NGVD.

B. Phase One. The first phase field exploration consisted of 16 core borings; 11 drilled in the river (CB-MPUC-C1 through CB-MPUC-C10R) and 5 drilled on land (CB-MPUC-L1 through CB-MPUC-L5). Also, laboratory testing was performed on some of the samples that were retrieved from the borings. The canal borings were drilled to approximate elevations ranging from -17.0 feet to -22.5 feet NGVD. The exception was boring CB-MPUC-C7, which was drilled to elevation -11.3 feet due to having encountered refusal. The land borings were drilled to depths of approximately 60 feet (elevations ranging from -56.0 to -59.0 feet NGVD).

The purpose of the 11 core borings that were drilled in the canal was to characterize the existing materials that would have to be dredged to achieve the project depth. Because most of the proposed sheet pile wall will be located land ward of the existing canal the 5 upland borings were drilled in this phase to obtain a preliminary assessment of the subsurface conditions along the proposed wall alignments along the two banks of the canal.

1) **Materials Encountered in Canal Borings.** Generally, the canal borings encountered very soft (zero blow count) black organic silty clay and silty clay with some waste debris in at least the upper approximate 8 feet of the borings.

At the western end of the project, boring CB-MPUC-C1 encountered zero blow count organic clay and silty clay throughout, to it's termination depth at elevation -22.4 feet.

Four of the next five borings, CB-MPUC-C2, CB-MPUC-C3, CB-MPUC-C4 and CB-MPUC-C5 encountered the zero blow count clay to elevations of -10 to -15 feet. This was generally underlain by very stiff to hard clay to the termination depths of the borings at the approximate elevations of -19 to -24.5 feet.

Boring CB-MPUC-7 encountered zero blow count organic clay in the upper approximate 1.5 feet underlain by a 1.5 foot layer of medium dense clayey sand in turn underlain by hard sandy silt to the termination depth of the boring at an elevation of -14.2 feet. This boring was terminated above its assigned termination elevation of -20 feet due to encountering refusal.

Zero blow count clay and peat was encountered throughout the depths of the four borings that were drilled on the eastern end of the canal. Of these four borings, boring CB-MPUC-8 encountered zero blow count organic clay and peat to an elevation of approximately -20 feet and three of the borings, CB-MPUC-C9, CB-MPUC-C10 and CB-MPUC-C10R encountered zero blow count peat to the termination depths of their borings at approximately -20.5 to -21.5 feet.

2) **Materials Encountered in Land Borings.** Generally, borings CB-MPUC-L1, CB-MPUC-L2 and CB-MPUC-L3 encountered gravely sand to clayey silt fill in the upper approximate 5 to 13 feet underlain by very soft organic clay to elevations of approximately -9 to -14 feet. These strata were in turn underlain by very stiff to hard silty clays and clayey silts to the termination depths of the borings at depths of 60 feet. Borings CB-MPUC-L4 and CB-MPUC-L5 generally encountered medium dense sandy gravel and silty sand to the approximate depth of 9 feet underlain by dense sand and stiff to hard clayey silt and clay to the termination depths of the borings at approximately 60 feet.

3) **Groundwater Levels.** For the canal borings, the ground surface was submerged. For the land borings, the groundwater levels varied between elevations of 0.4 feet in CB-MPUC-L2 to -3.4 feet in CB-MPUC-L4. It was anticipated that the groundwater levels would be between -1.0 and 1.0 feet NGVD. The reason that the groundwater level may have varied from the anticipated range was that insufficient time may have been allowed for the groundwater level to have been read after completion of the core boring.

4) **Laboratory Testing.** The laboratory testing consisted of geotechnical indexing tests and analytical tests. The geotechnical indexing tests included sieve analyses, Atterburg limits, field moisture test, specific gravity tests and visual classifications. The analytical tests included total organic carbon, oil and grease, total suspended solids, polynuclear aromatic hydrocarbons, pesticides and PCBs, total lead, total mercury and sulfides. However, because this is the geotechnical section of the report, the results of the analytical tests are not discussed here. A discussion of the results of the analytical tests is presented in the Environmental section of this report.

C. Phase Two. The second phase field exploration consisted of the drilling of 19 upland core borings, 28 test pits and laboratory testing. The borings were labeled CB-MP98-1 through CB-MP98-21. However, two borings that were planned, CB-MP98-18 and CB-MP98-19, were never drilled due to site access difficulties. The test pits were labeled TP-MP98-1 through TP-MP98-32. Four planned test pits, TP-MP98-23 and TP-MP98-26 through TP-MP98-28, also were never drilled due to site access difficulties.

All of the core borings of this phase were drilled along the anticipated alignment of the sheet pile wall for both banks of the canal in order to obtain data for the design of the wall. The borings were drilled to depths of approximately 50 to 51 feet.

The test pits were excavated within the boundaries of the proposed channel to provide better information on any debris that was present at the site than could be obtained by core borings. The test pits were excavated to depths of 9 to 12 feet.

1) **Materials Encountered.** Generally, the core borings encountered 2 to 8 feet of a sand, clayey sand or clayey gravel cap underlain by approximately 8 to 10 feet of debris and very soft organic clay and peat in turn underlain by much stiffer and denser materials which generally included very stiff to hard clays and very dense sands and clayey sands. Limestone was encountered in borings CB-MP98-4 and CB-MP98-5 at depths of approximately 40 feet (check) to the termination depth of those borings at approximately 50 feet. The limestone in these borings was located beneath the tip elevation of the sheet pile wall in that reach of the project. However, limestone was also encountered toward the east end of the canal in core boring CB-MP98-21, only at a shallower elevation of approximately -9.5 feet. The limestone in CB-MP98-21 continued to the termination depth of that boring at a depth of approximately -50.0 feet. The encountering of limestone at this shallow of a depth was unusual for this site and indicated a limestone outcrop in the area of Station CB-MPUC-21.

The test pits encountered a cap of sand, clayey sand or clayey gravel underlain by very soft peat, clay and debris throughout their depths. Generally, the test pits were excavated until the bottom of the debris was located. The debris consisted of construction materials, such as concrete blocks and wood, and household wastes, such as plastic bottles and containers. Other debris that was encountered included rubber tires and household appliances. The test pits are discussed in detail in the environmental section of this report.

2) **Groundwater Levels.** The groundwater levels were encountered in both the core borings and test pits at elevations ranging from -2.6 feet to 1.7 feet. These groundwater levels were influenced by the tidal waters of the adjacent canal and were, therefore, subject to the canal's tidal fluctuations.

3) **Laboratory Testing.** The laboratory testing consisted of geotechnical indexing tests and analytical tests. The geotechnical indexing tests included sieve analyses, Atterburg limits and visual classifications. A discussion of the results of the analytical tests is presented in the Environmental section of this report.

5. **Geotechnical Design Features.**

A. Sheet Pile Wall. In the earlier stages of the project, it was anticipated that the channel would be lined with a King pile wall system similar to the one that was constructed in the western end of the Martin Pena Canal several years ago. This King pile wall system consisted of pile bentsspaced 8 to 10 feet apart along the wall alignment and connected with wall panels. Each pile bent consisted of one 24-inch square concrete "King" pile, which was vertical, and one 18-inch square concrete batter pile,

However, during the design process it was found that the depth to a firm strata that could support the pile loads was shallower than in the earlier Martin Pena and Puerto Nuevo projects. This shallower depth to a firm strata would allow for the wall to be constructed of single vertical piles connected by panels in lieu of constructing pile bents of a vertical and a batter pile. As the design process continued, it was determined that a concrete-capped sheet pile wall system could support the lateral loads that would be exerted on whatever wall system was constructed.

It was estimate the cost of the concrete-capped sheet pile wall would be similar to that of the single vertical pile wall. However, the sheet pile wall design was chosen over the single vertical pile wall design for most of the channel principally because a sheet pile wall would be easier to repair if it was damaged by a boat or barge.

The sheet pile wall design will be used for most of the channel. However, it will not be used from Station 80+00 to Station 85+00 due to the anticipated difficulty in driving the sheet pile into the shallow limestone that was encountered in core boring CB-MP98-21. Along this reach, a single vertical pile wall will be constructed using steel H-piles. It is anticipated that a steel H-pile could be driven into the limestone. However, during construction a test pile will be driven and dynamic measurements will be taken to determine deriving criteria. If this dynamic pile load test indicates that the pile could not be driven without exceding maximum allowable compressive stresses or that the required tip elevation can not be achieved, the piles will be installed by preaugering and grouting.

1) Design Method. Both the sheet pile wall and the single concrete plumb pile wall was designed using the L-Pile Plus computer program. This program analyzes the response of a pile or sheet pile to lateral loading. This design is described in the Structures Appendix.

2) Soil Parameters for L-Pile Analysis. Geotechnical Branch analyzed the subsurface stratification and soil properties and provided that information for the L-Pile analysis. The information that was provided included the stratification, the soil types, saturated and unit weights ($\gamma_{sat,}$ γ_{moist}), cohesion (c) and angle of internal friction (ϕ) for each of the Unconsolidated Undrained (Q), 80% Consolidated Undrained (80%R) and Consolidate Drained (S) cases. Also provided were the L-Pile code for the soil type, the coefficient of horizontal subgrade reaction for both granular and cohesive soils and the value of strain at 50% the maximum stress (ε_{50}).

The shear strength parameters c and ϕ were for the S case was used for the granular soils in the L-Pile Plus analysis. However, the L-Pile Plus program could not handle an analysis with the drained (S) shear strength of a clay (i.e. given in terms of ϕ). Therefore, the Mohr-Colomb equation was used to determine the drained shear strength (τ) of the cohesive materials for the drained case L-Pile analysis. τ was, therefore, calculated at the top and bottom of each cohesive layer and provided as input for the L-Pile drained case analysis. The Mohr-Colomb equation that was used to calculate τ is as follows:

$$\tau = c + K\sigma_v' \tan \phi$$

where:

τ = shear strength
c = cohesion
σ_v' = vertical effective stress
K = lateral earth pressure coefficient (assumed to be 1)
ϕ = angle of internal friction

Eighty percent of the R strength was selected for the seismic analysis as per Makdisi and Seed, 1977. These investigators reported that "in order for significant strains to develop in a cohesive material, the cyclic stress level has to surpass the cyclic yield strength…the cyclic yield strength is typically in the range of 80% to 95% of the clay's static undrained strength. Therefore, 80% of the R strength for an seismic analysis is at the conservative end of the range suggested by Makdisi and Seed.

The data that was provided for the L-Pile analysis is shown in Tables 1 through 19 at the end of this appendix.

3) Installation. The sheet pile can be installed with a vibratory hammer. For sections of sheet pile that may not be able to be driven completely to the required tip elevation, a diesel, steam or hydraulic pile hammer can be used.

6. **Channel Dredging and Disposal**.

A. Disposal Area. The dredge and excavation spoil will be disposed of in deep holes that exist in the southeast area of the San Jose Lagoon. The reasons for the selection of this disposal area were environmental in nature and are discussed in the environmental section of this report.

B. Dredging Methods. Excavation techniques that can be used to remove the dense granular soils and the stiff to hard cohesive materials that were encountered in the upland borings, as well as the debris, include clam shell, drag line, back hoe for. The soft clays and silts in the existing canal can be dredged using hydraulic techniques.

C. Capping of Disposal Area. When the project is complete, the San Jose Lagoon disposal area will be capped using two feet of granular material free of environmental contaminants from an approved borrow source. Suitable materials for capping this disposal area will include materials satisfying the Unified Soil Classification System (USCS) designations SW, SP, GW, GP, SW-SC, SW-SM, GW-GC and GW-GM.

7. **Slopes of Channel Dredge Cuts Along the Channel Banks and In the Channel**.

A. Channel Bank Slopes. Because the topography of the project area is essentially flat with low relief and because any slope created along the canal alignment will be a temporary construction slope, with the exception of the embankments for the three bridge abutments, stability analysis was not considered necessary. Temporary construction slopes of 1V:3H are considered safe.

B. Underwater Dredge Slopes. The existing subsurface material in the canal are similar to those of San Juan Harbor, except for the presence of the debris in the Martin Pena Canal. The analysis of a recent dredge project in San Juan Harbor indicated that slopes of 1V:5H would be anticipated as a result of dredging. Therefore, since debris typically acts as reinforcement in a soft soil, a dredge slope of 1V:5H in the canal is considered conservative.

C. Excavation and Dredging Adjacent to Bridge Abutment Embankments and Pile Bents. The replacement of the three bridges that cross the canal along the project length will be accomplished by local agencies. If these bridges have not been replaced prior to construction of this project, the existing embankments will need to be protected by either not excavating within 100 feet of the embankment or by constructing a sheet-pile wall system to isolate them from the adjacent dredged areas.

The effects of dredging on the existing bridges could not be assessed because as-built plans of the existing bridge foundations do not exist. However, it is known that the pile caps for the Luis Munoz Rivera and Barbosa Bridges are at elevation -3 feet. Since the project will require dredging to below -10 feet and the pile tip elevations of the existing bridge foundations are not known, it was not possible to determine the impact that the project dredging would have on the capacities of the pile foundations of these bridges. It is, therefore, recommended that these bridges be replaced before dredging closer than 100 feet to these bridges.

For the Ponce de Leon Bridge, the pile cap elevations are at -8 feet. However, because of the width of the proposed channel at this bridge location it was determined that the necessary hydraulic performance could be achieved even if the channel excavation under the bridge were limited to -8 feet, which will be done as part of the project. Apparently, the channel in this vicinity once had a depth of at least -8 feet. For that reason it is anticipated that dredging of sediments to this elevation will not have an impact on the foundation capacity of the existing bridge. Therefore, replacement of the Ponce de Leon Bridge will not be required as part of this project.

TABLE 1 - Representative Soil Parameters
STATION 0+40 TO 10+00 North Bank (CB-MP98-1[1])

Elev. (Ft)	Soil Type	N[2] (Blows)	γ_{sat} (pcf)	γ_{moist} (pcf)	Q		80%R		S		τ^3 (psf)	L-Pile Soil Type[4]	Granular k^5 (pci)	Cohesive k^5 (pci)	ε_{50}
					C (psf)	ϕ (deg)	C (psf)	ϕ (deg)	C (psf)	ϕ (deg)					
3.3 to 0.3	SP	14	120	115	0	34	0	27	0	34	-	4	60	-	-
0.3 to -2.7	SP	5	120	115	0	30	0	24	0	30	-	4	20	-	-
-2.7 to -14.7	SC	17	120	115	450	22	180	21	0	30	-	7	60	-	-
-14.7 to -29.7	CH	26	125	120	3,750	0	1,500	10	0	25	621 1,059	2	-	1,000	0.005
-29.7 to -31.2	SP	33	125	120	0	38	0	30	0	38	-	4	125	-	-
-31.2 to -38.7	CH	30	125	120	3,750	0	1,500	10	0	25	1,103 1,322	2	-	1,000	0.005
-38.7 to -40.2	SP	30	125	120	0	38	0	30	0	38	-	4	125	-	-
-40.2 to -47.7	CH	24	125	120	3,750	0	1,500	10	0	25	1,366 1,585	2	-	1,000	0.005

Notes:

1. The subsurface stratification, blow count (N) and soil type shown was estimated from this core boring.

2. A typical blow count (N) was listed for the particular strata. High or low blow counts that were unusual for the strata were omitted and an average of the remainder blow counts were taken for this simplification.

3. τ is an equivalent shear strength for use in the lateral-load response computer program, L-Pile, for a drained strength (S) condition in a cohesive soil. The first and second τ listed for a given layer are values calculated for the top and bottom of that layer, respectively.

4. These numbers refer to the internal types of soil that were specified for the L-Pile computer program analysis for pile response to lateral load. See table ____ for the list of these soil types.

5. K refers to the soil-modulus parameter for *static* loading for use in the L-Pile computer program analysis for pile response to lateral load.

TABLE 2 - Representative Soil Parameters
STATION 10+00 TO 20+00 North Bank (CB-MP98-4[1])

Elev. (Ft)	Soil Type	N^2 (Blows)	γ_{sat} (pcf)	γ_{moist} (pcf)	Q C (psf)	Q ϕ (deg)	80%R C (psf)	80%R ϕ (deg)	S C (psf)	S ϕ (deg)	τ^3 (psf)	L-Pile Soil Type[4]	Granular k^5 (pci)	Cohesive k^5 (pci)	ε_{50}
2.4 to 0.9	GC	16	130	125	2,000	0	800	13	0	32	-	7	60	-	-
0.9 to -2.1	CH	8	115	110	1,000	0	400	8	0	20	-	2	-	100	0.010
-2.1 to -9.6	OH	1	90	85	125	0	50	6	0	16	128 175	1	30	-	0.020
-9.6 to -11.1	CH	7	115	110	1,000	0	400	8	0	20	123 280	2	-	100	0.010
-11.1 to -18.6	CH	17	120	115	2,000	0	800	10	0	23	327 510	2	-	500	0.005
-18.6 to -38.1	CH	28	125	120	3,750	0	1,500	10	0	25	560 1,130	2	-	1,000	0.005
-38.1 to -48.6	CH to GW[6]	25	130	125	2,500	0	1,000	14	0	34	-	2	-	2,000	0.005

Notes:

1. The subsurface stratification, blow count (N) and soil type shown was estimated from this core boring.

2. A typical blow count (N) was listed for the particular strata. High or low blow counts that were unusual for the strata were omitted and an average of the remainder blow counts were taken for this simplification.

3. τ is an equivalent shear strength for use in the lateral-load response computer program, L-Pile, for a drained strength (S) condition in a cohesive soil. The first and second τ listed for a given layer are values calculated for the top and bottom of that layer, respectively.

4. These numbers refer to the internal types of soil that were specified for the L-Pile computer program analysis for pile response to lateral load. See table ____ for the list of these soil types.

5. K refers to the soil-modulus parameter for *static* loading for use in the L-Pile computer program analysis for pile response to lateral load.

6. This was a weathered limestone formation that classified as a CH to GW material. The material was treated like a stiff clay in the L-Pile analysis and given a modulus of 2,000 pci to be conservative.

TABLE 3 - Representative Soil Parameters
STATION 20+00 TO 34+00 North Bank (CB-MP98-6[1])

Elev. (Ft)	Soil Type	N^2 (Blows)	γ_{sat} (pcf)	γ_{moist} (pcf)	Q		80%R		S		τ^3 (psf)	L-Pile Soil Type[4]	Granular k^5 (pci)	Cohesive k^5 (pci)	ε_{50}
					C (psf)	ϕ (deg)	C (psf)	ϕ (deg)	C (psf)	ϕ (deg)					
2.6 to 1.1	Asphalt material to be removed.														
1.1 to -1.9	CL	20	123	118	2,500	0	1,000	10	0	24	-	2	-	1,000	0.005
-1.9 to -6.4	Pt	P to 2	90	85	125	0	50	6	0	16	-	1	-	30	0.020
-6.4 to -15.4	CL	15	120	115	2,000	0	800	9	0	23	274 494	2	-	500	0.005
-15.4 to -16.9	SW	19	125	120	0	32	0	25.5	0	32	-	4	60	-	-
-16.9 to -45.4	CH	22	125	120	3,750	0	1,500	10	0	25	587 1,419	2	-	1,000	0.005
-45.4 to -48.4	SC	23	123	118	500	24	200	22.5	0	32	-	7	125	-	-

Notes:

1. The subsurface stratification, blow count (N) and soil type shown was estimated from this core boring.

2. A typical blow count (N) was listed for the particular strata. High or low blow counts that were unusual for the strata were omitted and an average of the remainder blow counts were taken for this simplification.

3. τ is an equivalent shear strength for use in the lateral-load response computer program, L-Pile, for a drained strength (S) condition in a cohesive soil. The first and second τ listed for a given layer are values calculated for the top and bottom of that layer, respectively.

4. These numbers refer to the internal types of soil that were specified for the L-Pile computer program analysis for pile response to lateral load. See table ____ for the list of these soil types.

5. K refers to the soil-modulus parameter for *static* loading for use in the L-Pile computer program analysis for pile response to lateral load.

TABLE 4 - Representative Soil Parameters
STATION 34+00 TO 41+00 North Bank (CB-MP98-11[1])

Elev. (Ft)	Soil Type	N^2 (Blows)	γ_{sat} (pcf)	γ_{moist} (pcf)	Q C (psf)	Q ϕ (deg)	80%R C (psf)	80%R ϕ (deg)	S C (psf)	S ϕ (deg)	τ^3 (psf)	L-Pile Soil Type[4]	Granular k^5 (pci)	Cohesive k^5 (pci)	ε_{50}
1.5 to 0.0	SM	6	120	115	0	28	0	22.5	0	28	-	7	40	-	-
0.0 to -9.0	OH	2	90	85	125	0	50	6	0	16	52 123	1	-	30	0.020
-9.0 to -15.0	CL	6	115	110	750	0	300	6	0	16	123 213	1	-	60	0.010
-15.0 to -27.0	CL	19	120	115	2,000	0	800	9	0	23	316 609	2	-	1,000	0.005
-27.0 to -45.0	CH	43	135	130	5,000	0	2,000	13	0	32	897 1,713	2	-	2,000	0.005

Notes:

1. The subsurface stratification, blow count (N) and soil type shown was estimated from this core boring.

2. A typical blow count (N) was listed for the particular strata. High or low blow counts that were unusual for the strata were omitted and an average of the remainder blow counts were taken for this simplification.

3. τ is an equivalent shear strength for use in the lateral-load response computer program, L-Pile, for a drained strength (S) condition in a cohesive soil. The first and second τ listed for a given layer are values calculated for the top and bottom of that layer, respectively.

4. These numbers refer to the internal types of soil that were specified for the L-Pile computer program analysis for pile response to lateral load. See table ____ for the list of these soil types.

5. K refers to the soil-modulus parameter for *static* loading for use in the L-Pile computer program analysis for pile response to lateral load.

TABLE 5- Representative Soil Parameters
STATION 41+00 TO 54+00 North Bank (CB-MP98-13[1])

Elev. (Ft)	Soil Type	N^2 (Blows)	γ_{sat} (pcf)	γ_{moist} (pcf)	Q C (psf)	Q ϕ (deg)	80%R C (psf)	80%R ϕ (deg)	S C (psf)	S ϕ (deg)	τ^3 (psf)	L-Pile Soil Type[4]	Granular k^5 (pci)	Cohesive k^5 (pci)	ε_{50}
2.1 to -0.9	SP	16	120	115	0	34	0	27	0	34	-	4	60	-	-
-0.9 to -2.4	CL	15	120	115	2,000	0	800	9	0	23	-	2		500	0.005
-2.4 to -3.9	SW	5	115	110	0	30	0	24	0	30	-	4	20	-	-
-3.9 to -14.4	OH	P	90	85	125	0	50	6	0	16	124 207	1	-	30	0.020
-14.4 to -23.4	CH	9	115	110	1,000	0	400	8	0	20	263 435	2	-	100	0.010
-23.4 to -48.9	CL	25	125	120	2,500	0	1,000	10	0	25	558 1,302	2	-	1,500	0.005

Notes:

1. The subsurface stratification, blow count (N) and soil type shown was estimated from this core boring.

2. A typical blow count (N) was listed for the particular strata. High or low blow counts that were unusual for the strata were omitted and an average of the remainder blow counts were taken for this simplification.

3. τ is an equivalent shear strength for use in the lateral-load response computer program, L-Pile, for a drained strength (S) condition in a cohesive soil. The first and second τ listed for a given layer are values calculated for the top and bottom of that layer, respectively.

4. These numbers refer to the internal types of soil that were specified for the L-Pile computer program analysis for pile response to lateral load. See table ____ for the list of these soil types.

5. K refers to the soil-modulus parameter for *static* loading for use in the L-Pile computer program analysis for pile response to lateral load.

TABLE 6- Representative Soil Parameters
STATION 54+00 TO 63+00 North Bank (CB-MP98-14[1])

Elev. (Ft)	Soil Type	N^2 (Blows)	γ_{sat} (pcf)	γ_{moist} (pcf)	Q		80%R		S		τ^3 (psf)	L-Pile Soil Type[4]	Granular k^5 (pci)	Cohesive k^5 (pci)	ε_{50}
					C (psf)	ϕ (deg)	C (psf)	ϕ (deg)	C (psf)	ϕ (deg)					
2.6 to 1.1	CL	15	120	115	2,000	0	800	9	0	23	-	2	-	500	0.005
1.1 to -1.9	CL	4	110	105	500	0	200	6	0	14	-	1	-	30	0.020
-1.9 to -3.4	SW	9	115	110	0	30	0	24	0	30	-	4	20	-	-
-3.4 to -13.9	Pt	1	90	85	125	0	50	6	0	16	115 198	1	-	30	0.020
-13.9 to -19.9	CH	6	110	105	500	0	200	7	0	18	225 318	1	-	100	0.010
-19.9 to -22.9	CH	22	125	120	3,750	0	1,500	10	0	25	456 543	2	-	1,000	0.005
-22.9 to -46.9	CH	44	135	130	5,000	0	2,000	13	0	32	728 1,817	2	-	2,000	0.005
-46.9 to -48.4	SC	39	125	120	750	26	300	24	0	34	-	7	125	-	-

Notes:

1. The subsurface stratification, blow count (N) and soil type shown was estimated from this core boring.

2. A typical blow count (N) was listed for the particular strata. High or low blow counts that were unusual for the strata were omitted and an average of the remainder blow counts were taken for this simplification.

3. τ is an equivalent shear strength for use in the lateral-load response computer program, L-Pile, for a drained strength (S) condition in a cohesive soil. The first and second τ listed for a given layer are values calculated for the top and bottom of that layer, respectively.

4. These numbers refer to the internal types of soil that were specified for the L-Pile computer program analysis for pile response to lateral load. See table ____ for the list of these soil types.

5. K refers to the soil-modulus parameter for *static* loading for use in the L-Pile computer program analysis for pile response to lateral load.

TABLE 7 - Representative Soil Parameters
STATION 63+00 TO 77+00 North Bank (CB-MP98-16[1])

Elev. (Ft)	Soil Type	N^2 (Blows)	γ_{sat} (pcf)	γ_{moist} (pcf)	Q		80%R		S		τ^3 (psf)	L-Pile Soil Type[4]	Granular k^5 (pci)	Cohesive k^5 (pci)	ε_{50}
					C (psf)	ϕ (deg)	C (psf)	ϕ (deg)	C (psf)	ϕ (deg)					
3.3 to 0.3	SW	6	115	110	0	30	0	24	0	30	-	4	20	-	-
0.3 to -5.7	Debris to be removed														
-5.7 to -8.7	OH	P	90	85	125	0	50	6	0	16	146 170	1	-	30	0.020
-8.7 to -34.2	CH	18	120	115	2,500	0	1,000	10	0	24	263 917	2	-	1,000	0.005
-34.2 to -37.2	CL	11	120	115	1,000	0	400	8	0	20	750 813	2	-	500	0.010
-37.2 to -47.7	GC[6]	25	130	125	3,000	0	1,200	14.5	0	36	-	2	-	2,000	0.005

Notes:

1. The subsurface stratification, blow count (N) and soil type shown was estimated from this core boring.

2. A typical blow count (N) was listed for the particular strata. High or low blow counts that were unusual for the strata were omitted and an average of the remainder blow counts were taken for this simplification.

3. τ is an equivalent shear strength for use in the lateral-load response computer program, L-Pile, for a drained strength (S) condition in a cohesive soil. The first and second τ listed for a given layer are values calculated for the top and bottom of that layer, respectively.

4. These numbers refer to the internal types of soil that were specified for the L-Pile computer program analysis for pile response to lateral load. See table ____ for the list of these soil types.

5. K refers to the soil-modulus parameter for *static* loading for use in the L-Pile computer program analysis for pile response to lateral load.

6. This was a weathered limestone formation that classified as a GC material. The material was treated like a stiff clay in the L-Pile analysis and given a modulus of 2,000 pci to be conservative.

TABLE 8 - Representative Soil Parameters
STATION 77+00 TO 81+00 North Bank (CB-MP98-20[1])

Elev. (Ft)	Soil Type	N^2 (Blows)	γ_{sat} (pcf)	γ_{moist} (pcf)	Q C (psf)	Q ϕ (deg)	80%R C (psf)	80%R ϕ (deg)	S C (psf)	S ϕ (deg)	τ^3 (psf)	L-Pile Soil Type[4]	Granular k^5 (pci)	Cohesive k^5 (pci)	ε_{50}
2.8 to -0.2	ML	11	120	115	1,000	0	400	8	0	20	-	7	500	-	-
-0.2 to -7.7	OH	2	90	85	125	0	50	6	0	16	-	1	-	30	0.020
-7.7 to -10.7	CH	10	120	115	2,000	0	800	10	0	23	241 314	1	-	100	0.005
-10.7 to -28.7	CH	44	135	130	5,000	0	2,000	13	0	32	462 1,279	2	-	2,000	0.005
-28.7 to -34.7	SP	44	125	120	0	38	0	30	0	38	-	4	125	-	-
-34.7 to -36.2	CL	67	135	130	5,000	0	2,000	13	0	32	1,514 1,582	2	-	2,000	0.005
-36.2 to -40.7	SP	29	125	120	0	38	0	30	0	38	-	4	125	-	-
-40.7 to -48.2	CH	47	135	130	5,000	0	2,000	13	0	32	1,758 2,051	2	-	2,000	0.005

Notes:

1. The subsurface stratification, blow count (N) and soil type shown was estimated from this core boring.

2. A typical blow count (N) was listed for the particular strata. High or low blow counts that were unusual for the strata were omitted and an average of the remainder blow counts were taken for this simplification.

3. τ is an equivalent shear strength for use in the lateral-load response computer program, L-Pile, for a drained strength (S) condition in a cohesive soil. The first and second τ listed for a given layer are values calculated for the top and bottom of that layer, respectively.

4. These numbers refer to the internal types of soil that were specified for the L-Pile computer program analysis for pile response to lateral load. See table ____ for the list of these soil types.

5. K refers to the soil-modulus parameter for *static* loading for use in the L-Pile computer program analysis for pile response to lateral load.

TABLE 9 - Representative Soil Parameters
STATION 81+00 TO 87+00 North Bank (CB-MP98-21[1])

Elev. (Ft)	Soil Type	N^2 (Blows)	γ_{sat} (pcf)	γ_{moist} (pcf)	Q		80%R		S		τ^3 (psf)	L-Pile Soil Type[4]	Granular k^5 (pci)	Cohesive k^5 (pci)	ε_{50}
					C (psf)	ϕ (deg)	C (psf)	ϕ (deg)	C (psf)	ϕ (deg)					
1.0 to -5.0	CL & GW	8	120	115	1,000	0	400	7	0	18	-	7	30	-	-
-5.0 to -9.5	GC	25	130	125	2,500	0	1,000	14	0	34	-	7	125	-	-
-9.5 to -20.0	GC[6]	70	130	125	3,000	0	1,200	14	0	36	-	2	-	2,000	0.005
-20.0 to -50.0	CL[6]	32	130	125	3,000	0	1,200	13	0	32	-	2	-	2,000	0.005

Notes:

1. The subsurface stratification, blow count (N) and soil type shown was estimated from this core boring.

2. A typical blow count (N) was listed for the particular strata. High or low blow counts that were unusual for the strata were omitted and an average of the remainder blow counts were taken for this simplification.

3. τ is an equivalent shear strength for use in the lateral-load response computer program, L-Pile, for a drained strength (S) condition in a cohesive soil. The first and second τ listed for a given layer are values calculated for the top and bottom of that layer, respectively.

4. These numbers refer to the internal types of soil that were specified for the L-Pile computer program analysis for pile response to lateral load. See table ____ for the list of these soil types.

5. K refers to the soil-modulus parameter for *static* loading for use in the L-Pile computer program analysis for pile response to lateral load.

6. These strata were a weathered limestone formation that classified as a GC and CL materials. The materials were treated like a stiff clay in the L-Pile analysis and given a modulus of 2,000 pci to be conservative.

TABLE 10 - Representative Soil Parameters
STATION 87+00 TO 101+00 North Bank (CB-MP98-22[1])

Elev. (Ft)	Soil Type	N^2 (Blows)	γ_{sat} (pcf)	γ_{moist} (pcf)	Q C (psf)	Q ϕ (deg)	80%R C (psf)	80%R ϕ (deg)	S C (psf)	S ϕ (deg)	τ^3 (psf)	L-Pile Soil Type[4]	Granular k^5 (pci)	Cohesive k^5 (pci)	ε_{50}
0.9 to -5.1	Debris to be removed.														
-5.1 to -23.1	OH to CH	P	90	85	125	0	50	6	0	16	115 258	1	-	30	0.020
-23.1 to -29.1	CH	14	120	115	2,000	0	800	10	0	23	386 528	2	-	500	0.005
-29.1 to -41.1	CH to CL	28	125	120	3,750	0	1,900	13	0	25	580 930	2	-	1,000	0.005
-41.1 to -42.6	SP	17	125	120	0	38	0	30	0	38	-	4	125	-	-
-42.6 to -50.1	CL, SP, SC & CH[6]	31	130	125	3,000	0	1,200	13	0	32	-	2	-	2,000	0.005

Notes:

1. The subsurface stratification, blow count (N) and soil type shown was estimated from this core boring.

2. A typical blow count (N) was listed for the particular strata. High or low blow counts that were unusual for the strata were omitted and an average of the remainder blow counts were taken for this simplification.

3. τ is an equivalent shear strength for use in the lateral-load response computer program, L-Pile, for a drained strength (S) condition in a cohesive soil. The first and second τ listed for a given layer are values calculated for the top and bottom of that layer, respectively.

4. These numbers refer to the internal types of soil that were specified for the L-Pile computer program analysis for pile response to lateral load. See table ____ for the list of these soil types.

5. K refers to the soil-modulus parameter for *static* loading for use in the L-Pile computer program analysis for pile response to lateral load.

6. This was a weathered limestone formation that classified as CL, SP, SC and CH materials from top to bottom of the strata. The material was treated like a stiff clay in the L-Pile analysis and given a modulus of 2,000 pci to be conservative.

TABLE 11 - Representative Soil Parameters
STATION 1+00 TO 8+00 South Bank (CB-MP98-2[1])

Elev. (Ft)	Soil Type	N^2 (Blows)	γ_{sat} (pcf)	γ_{moist} (pcf)	Q C (psf)	Q ϕ (deg)	80%R C (psf)	80%R ϕ (deg)	S C (psf)	S ϕ (deg)	τ^3 (psf)	L-Pile Soil Type[4]	Granular k^5 (pci)	Cohesive k^5 (pci)	ε_{50}
6.4 to 0.4	GC	5	130	125	500	0	200	10	0	25	-	7	20	-	-
0.4 to -7.1	SP-SM	6	120	115	0	28	0	22.5	0	28	-	7	20	-	-
-7.1 to -14.6	CL	25	125	120	2,500	0	1,000	10	0	25	565 784	2	-	1,500	0.005
-14.6 to -17.6	CL	13	120	115	2,000	0	800	9	0	23	714 872	2	-	500	0.005
-17.6 to -19.1	SC	12	120	115	400	21	160	20	0	28	-	7	60	-	-
-19.1 to -26.6	CH	27	125	120	3,750	0	1,500	10	0	25	912 1,131	2	-	1,000	0.005
-26.6 to -28.1	SM	27	125	120	550	25	220	23	0	33	-	7	60	-	-
-28.1 to -32.6	CH	25	125	120	3,750	0	1,500	10	0	25	1,171 1,303	2	-	1,000	0.005
-32.6 to -44.6	SP-SM	20	125	120	0	32	0	25.5	0	32	-	7	60	-	-

Notes:

1. The subsurface stratification, blow count (N) and soil type shown was estimated from this core boring.

2. A typical blow count (N) was listed for the particular strata. High or low blow counts that were unusual for the strata were omitted and an average of the remainder blow counts were taken for this simplification.

3. τ is an equivalent shear strength for use in the lateral-load response computer program, L-Pile, for a drained strength (S) condition in a cohesive soil. The first and second τ listed for a given layer are values calculated for the top and bottom of that layer, respectively.

4. These numbers refer to the internal types of soil that were specified for the L-Pile computer program analysis for pile response to lateral load. See table ____ for the list of these soil types.

5. K refers to the soil-modulus parameter for *static* loading for use in the L-Pile computer program analysis for pile response to lateral load.

TABLE 12 - Representative Soil Parameters
STATION 8+00 TO 15+00 South Bank (CB-MP98-3[1])

Elev. (Ft)	Soil Type	N^2 (Blows)	γ_{sat} (pcf)	γ_{moist} (pcf)	Q C (psf)	Q ϕ (deg)	80%R C (psf)	80%R ϕ (deg)	S C (psf)	S ϕ (deg)	τ^3 (psf)	L-Pile Soil Type[4]	Granular k^5 (pci)	Cohesive k^5 (pci)	ε_{50}
4.5 to -4.5	GW	14	130	125	500	10	200	15	0	28	-	4	60	-	-
-4.5 to -10.5	OH	1	90	85	125	0	50	6	0	16	264 311	1	-	30	0.020
-10.5 to -15.0	SC	4	120	110	250	20	100	18	0	26	-	7	20	-	-
-15.0 to -19.5	SC	24	123	118	500	24	200	22.5	0	32	-	7	60	-	-
-19.5 to -24.0	CH	21	125	120	3,750	0	1,500	10	0	25	759 890	2	-	1,000	0.005
-24.0 to -36.0	CL	16	120	115	2,000	0	800	9	0	23	810 1,104	2	-	1,000	0.005
-36.0 to -46.5	MH	26	125	120	2,500	0	1,000	10	0	25	1,212 1,240	2	-	1,000	0.005

Notes:

1. The subsurface stratification, blow count (N) and soil type shown was estimated from this core boring.

2. A typical blow count (N) was listed for the particular strata. High or low blow counts that were unusual for the strata were omitted and an average of the remainder blow counts were taken for this simplification.

3. τ is an equivalent shear strength for use in the lateral-load response computer program, L-Pile, for a drained strength (S) condition in a cohesive soil. The first and second τ listed for a given layer are values calculated for the top and bottom of that layer, respectively.

4. These numbers refer to the internal types of soil that were specified for the L-Pile computer program analysis for pile response to lateral load. See table ____ for the list of these soil types.

5. K refers to the soil-modulus parameter for *static* loading for use in the L-Pile computer program analysis for pile response to lateral load.

TABLE 13 - Representative Soil Parameters
STATION 15+00 TO 30+00 South Bank (CB-MP98-5[1])

Elev. (Ft)	Soil Type	N^2 (Blows)	γ_{sat} (pcf)	γ_{moist} (pcf)	Q		80%R		S		τ^3 (psf)	L-Pile Soil Type[4]	Granular k^5 (pci)	Cohesive k^5 (pci)	ε_{50}
					C (psf)	ϕ (deg)	C (psf)	ϕ (deg)	C (psf)	ϕ (deg)					
2.8 to -0.2	CL	11	120	115	1,000	0	400	8	0	20	-	3	-	500	0.005
-0.2 to -1.7	GC	14	130	125	2,000	0	800	12	0	30	-	7	60	-	-
-1.7 to -9.2	OH	2	90	85	125	0	50	6	0	16	69 86	1	-	30	0.020
-9.2 to -15.2	CL	13	120	115	2,000	0	800	9	0	23	349 496	2	-	500	0.005
-15.2 to -16.7	SC	24	123	118	500	24	200	22.5	0	32	-	7	60	-	-
-16.7 to -42.2	CH	22	125	120	3,750	0	1,500	10	0	25	587 1,331	2	-	1,000	0.005
-42.2 to -48.2	GC[6]	23	130	125	2,300	0	920	13	0	33	-	2	-	2,000	0.005

Notes:

1. The subsurface stratification, blow count (N) and soil type shown was estimated from this core boring.

2. A typical blow count (N) was listed for the particular strata. High or low blow counts that were unusual for the strata were omitted and an average of the remainder blow counts were taken for this simplification.

3. τ is an equivalent shear strength for use in the lateral-load response computer program, L-Pile, for a drained strength (S) condition in a cohesive soil. The first and second τ listed for a given layer are values calculated for the top and bottom of that layer, respectively.

4. These numbers refer to the internal types of soil that were specified for the L-Pile computer program analysis for pile response to lateral load. See table ____ for the list of these soil types.

5. K refers to the soil-modulus parameter for *static* loading for use in the L-Pile computer program analysis for pile response to lateral load.

6. This was a weathered limestone formation that classified as a GC material. The material was treated like a stiff clay in the L-Pile analysis and given a modulus of 2,000 pci to be conservative.

TABLE 14 - Representative Soil Parameters
STATION 30+00 TO 33+00 South Bank (CB-MP98-8[1])

Elev. (Ft)	Soil Type	N[2] (Blows)	γ_{sat} (pcf)	γ_{moist} (pcf)	Q		80%R		S		τ[3] (psf)	L-Pile Soil Type[4]	Granular k[5] (pci)	Cohesive k[5] (pci)	ε_{50}
					C (psf)	ϕ (deg)	C (psf)	ϕ (deg)	C (psf)	ϕ (deg)					
3.3 to 0.3	SC	14	120	115	425	22	170	21	0	30	-	7	60	-	-
0.3 to -2.7	CH	5	110	105	500	0	200	7	0	18	117 194	1	-	30	0.020
-2.7 to -4.2	OL	15	120	115	2,000	0	800	8	0	20	-	2	-	500	0.010
-4.2 to -5.7	SP	12	120	115	0	32	0	25.6	0	32	-	4	60	-	-
-5.7 to -8.7	CL	6	115	110	750	0	300	6	0	16	221 266	1	-	60	0.010
-8.7 to -25.2	CH	24	125	120	3,750	0	1,500	10	0	25	432 870	2	-	1,500	0.005
-25.2 to -47.7	CH	45	135	130	5,000	0	2,000	13	0	32	1,166 2,187	2	-	2,000	0.005

Notes:

1. The subsurface stratification, blow count (N) and soil type shown was estimated from this core boring.

2. A typical blow count (N) was listed for the particular strata. High or low blow counts that were unusual for the strata were omitted and an average of the remainder blow counts were taken for this simplification.

3. τ is an equivalent shear strength for use in the lateral-load response computer program, L-Pile, for a drained strength (S) condition in a cohesive soil. The first and second τ listed for a given layer are values calculated for the top and bottom of that layer, respectively.

4. These numbers refer to the internal types of soil that were specified for the L-Pile computer program analysis for pile response to lateral load. See table ____ for the list of these soil types.

5. K refers to the soil-modulus parameter for *static* loading for use in the L-Pile computer program analysis for pile response to lateral load.

TABLE 15 - Representative Soil Parameters STATION 33+00 TO 50+00 South Bank (CB-MP98-12[1])															
Elev. (Ft)	Soil Type	N^2 (Blows)	γ_{sat} (pcf)	γ_{moist} (pcf)	Q		80%R		S		τ^3 (psf)	L-Pile Soil Type[4]	Granular k^5 (pci)	Cohesive k^5 (pci)	ε_{50}
					C (psf)	ϕ (deg)	C (psf)	ϕ (deg)	C (psf)	ϕ (deg)					
2.0 to -5.5	CL	7	120	115	1,000	0	400	7	0	18	-	2	-	100	0.010
-5.5 to -13.5	Pt to ML	P	90	85	125	0	50	6	0	16	176 239	1	-	30	0.020
-13.5 to -31.0	CH to MH	11	120	115	2,000	0	800	12	0	23	354 782	2	-	500	0.005
-31.0 to -49.0	CH	24	125	120	3,750	0	1,500	10	0	25	859 1,384	2	-	1,000	0.005

Notes:

1. The subsurface stratification, blow count (N) and soil type shown was estimated from this core boring.

2. A typical blow count (N) was listed for the particular strata. High or low blow counts that were unusual for the strata were omitted and an average of the remainder blow counts were taken for this simplification.

3. τ is an equivalent shear strength for use in the lateral-load response computer program, L-Pile, for a drained strength (S) condition in a cohesive soil. The first and second τ listed for a given layer are values calculated for the top and bottom of that layer, respectively.

4. These numbers refer to the internal types of soil that were specified for the L-Pile computer program analysis for pile response to lateral load. See table ____ for the list of these soil types.

5. K refers to the soil-modulus parameter for *static* loading for use in the L-Pile computer program analysis for pile response to lateral load.

TABLE 16 - Representative Soil Parameters
STATION 50+00 TO 64+00 South Bank (CB-MP98-15[1])

Elev. (Ft)	Soil Type	N^2 (Blows)	γ_{sat} (pcf)	γ_{moist} (pcf)	Q		80%R		S		τ^3 (psf)	L-Pile Soil Type[4]	Granular k^5 (pci)	Cohesive k^5 (pci)	ε_{50}
					C (psf)	ϕ (deg)	C (psf)	ϕ (deg)	C (psf)	ϕ (deg)					
0.6 to -6.9	CL	8	120	115	1,000	0	400	7	0	18	0 153	2	-	100	0.010
-6.9 to -12.9	OH	1	90	85	125	0	50	6	0	16	135 182	1	-	30	0.020
-12.9 to -16.9	CH	5	110	105	500	0	200	7	0	18	206 253	2	-	60	0.020
-16.4 to -50.4	CL to CH	34	135	130	5,000	0	2,000	10	0	25	363 1,450	2	-	2,000	0.005

Notes:

1. The subsurface stratification, blow count (N) and soil type shown was estimated from this core boring.

2. A typical blow count (N) was listed for the particular strata. High or low blow counts that were unusual for the strata were omitted and an average of the remainder blow counts were taken for this simplification.

3. τ is an equivalent shear strength for use in the lateral-load response computer program, L-Pile, for a drained strength (S) condition in a cohesive soil. The first and second τ listed for a given layer are values calculated for the top and bottom of that layer, respectively.

4. These numbers refer to the internal types of soil that were specified for the L-Pile computer program analysis for pile response to lateral load. See table ____ for the list of these soil types.

5. K refers to the soil-modulus parameter for *static* loading for use in the L-Pile computer program analysis for pile response to lateral load.

TABLE 17 - Representative Soil Parameters
STATION 64+00 TO 81+00 South Bank (CB-MP98-17[1])

Elev. (Ft)	Soil Type	N^2 (Blows)	γ_{sat} (pcf)	γ_{moist} (pcf)	Q		80%R		S		τ^3 (psf)	L-Pile Soil Type[4]	Granular k^5 (pci)	Cohesive k^5 (pci)	ε_{50}
					C (psf)	ϕ (deg)	C (psf)	ϕ (deg)	C (psf)	ϕ (deg)					
2.7 to -3.3	GC	9	120	115	1,000	0	400	11	0	28	-	7	40	-	-
-3.3 to -10.8	Pt	P	90	85	125	0	50	6	0	16	134 194	1	-	30	0.020
-10.8 to -30.3	CH	34	135	130	4,300	0	1,720	11	0	28	359 1,112	2	-	2,000	0.005
-30.3 to -33.3	SP	57	125	120	0	38	0	30	0	38	-	4	125	-	-
-33.3 to -48.3	CL[6]	35	130	125	3,000	0	1,200	13	0	32	-	2	-	2,000	0.005

Notes:

1. The subsurface stratification, blow count (N) and soil type shown was estimated from this core boring.

2. A typical blow count (N) was listed for the particular strata. High or low blow counts that were unusual for the strata were omitted and an average of the remainder blow counts were taken for this simplification.

3. τ is an equivalent shear strength for use in the lateral-load response computer program, L-Pile, for a drained strength (S) condition in a cohesive soil. The first and second τ listed for a given layer are values calculated for the top and bottom of that layer, respectively.

4. These numbers refer to the internal types of soil that were specified for the L-Pile computer program analysis for pile response to lateral load. See table ____ for the list of these soil types.

5. K refers to the soil-modulus parameter for *static* loading for use in the L-Pile computer program analysis for pile response to lateral load.

6. This was a weathered limestone formation that classified as a CL material. The material was treated like a stiff clay in the L-Pile analysis and given a modulus of 2,000 pci to be conservative.

TABLE 18 - Representative Soil Parameters
STATION 81+00 TO 87+00 South Bank (CB-MP98-21[1])

Elev. (Ft)	Soil Type	N^2 (Blows)	γ_{sat} (pcf)	γ_{moist} (pcf)	Q C (psf)	Q ϕ (deg)	80%R C (psf)	80%R ϕ (deg)	S C (psf)	S ϕ (deg)	τ^3 (psf)	L-Pile Soil Type[4]	Granular k^5 (pci)	Cohesive k^5 (pci)	ε_{50}
1.0 to -5.0	CL & GW	8	120	115	1,000	0	400	7	0	18	-	7	30	-	-
-5.0 to -9.5	GC	25	130	125	2,500	0	1,000	14	0	34	-	7	125	-	-
-9.5 to -20.0	GC[6]	70	130	125	3,000	0	1,200	14	0	36	-	2	-	2,000	0.005
-20.0 to -50.0	CL[6]	32	130	125	3,000	0	1,200	13	0	32	-	2	-	2,000	0.005

Notes:

1. The subsurface stratification, blow count (N) and soil type shown was estimated from this core boring.

2. A typical blow count (N) was listed for the particular strata. High or low blow counts that were unusual for the strata were omitted and an average of the remainder blow counts were taken for this simplification.

3. τ is an equivalent shear strength for use in the lateral-load response computer program, L-Pile, for a drained strength (S) condition in a cohesive soil. The first and second τ listed for a given layer are values calculated for the top and bottom of that layer, respectively.

4. These numbers refer to the internal types of soil that were specified for the L-Pile computer program analysis for pile response to lateral load. See table ____ for the list of these soil types.

5. K refers to the soil-modulus parameter for *static* loading for use in the L-Pile computer program analysis for pile response to lateral load.

6. These strata were a weathered limestone formation that classified as a GC and CL materials. The materials were treated like a stiff clay in the L-Pile analysis and given a modulus of 2,000 pci to be conservative.

TABLE 19 - Representative Soil Parameters
STATION 87+00 TO 101+00 South Bank (CB-MP98-22[1])

Elev. (Ft)	Soil Type	N^2 (Blows)	γ_{sat} (pcf)	γ_{moist} (pcf)	Q		80%R		S		τ^3 (psf)	L-Pile Soil Type[4]	Granular k^5 (pci)	Cohesive k^5 (pci)	ε_{50}
					C (psf)	ϕ (deg)	C (psf)	ϕ (deg)	C (psf)	ϕ (deg)					
0.9 to -5.1	Debris to be removed.														
-5.1 to -23.1	OH to CH	P	90	85	125	0	50	6	0	16	115 258	1	-	30	0.020
-23.1 to -29.1	CH	14	120	115	2,000	0	800	10	0	23	386 528	2	-	500	0.005
-29.1 to -41.1	CH to CL	28	125	120	3,750	0	1,900	13	0	25	580 930	2	-	1,000	0.005
-41.1 to -42.6	SP	17	125	120	0	38	0	30	0	38	-	4	125	-	-
-42.6 to -50.1	CL, SP, SC & CH[6]	31	130	125	3,000	0	1,200	13	0	32	-	2	-	2,000	0.005

Notes:

1. The subsurface stratification, blow count (N) and soil type shown was estimated from this core boring.

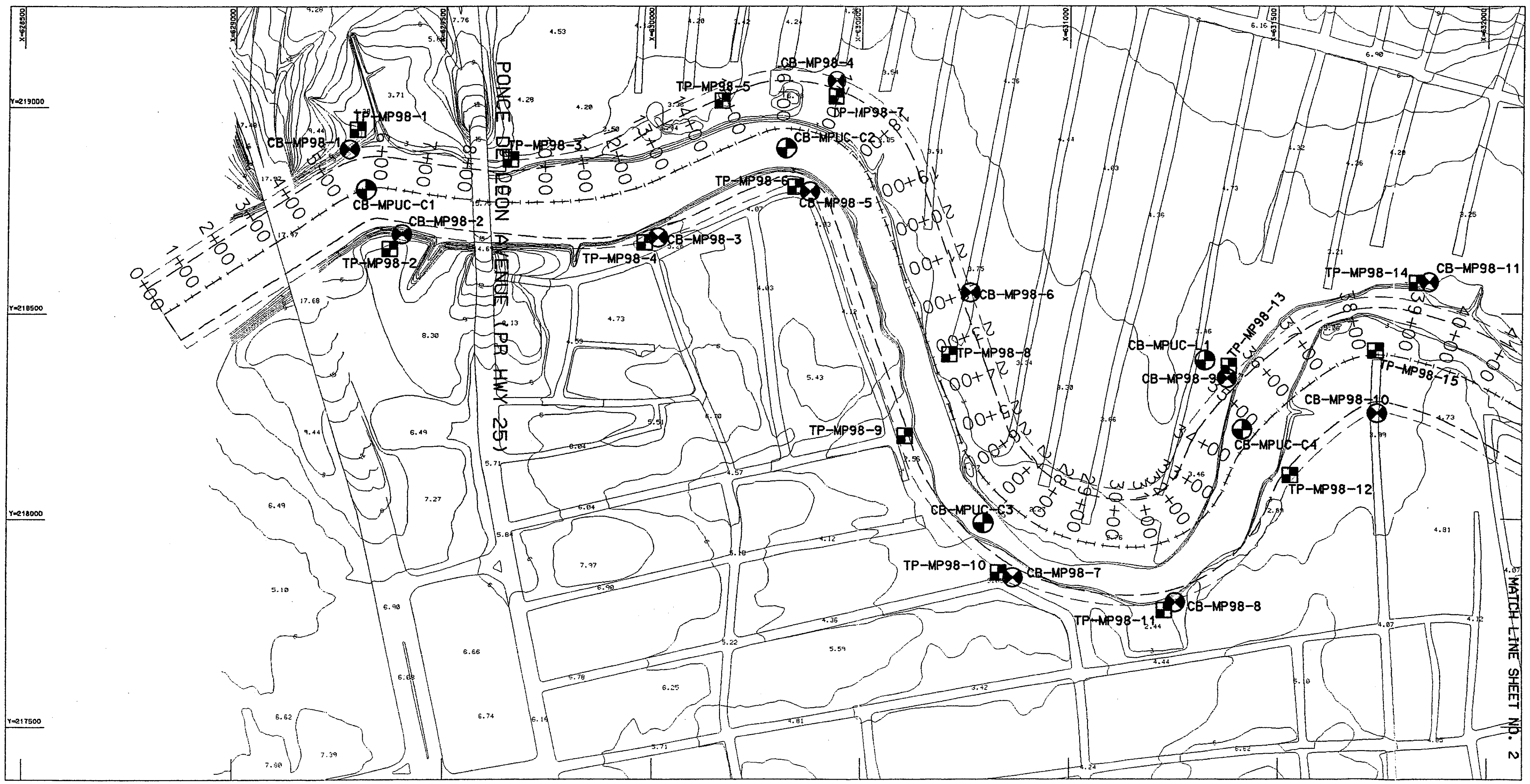
2. A typical blow count (N) was listed for the particular strata. High or low blow counts that were unusual for the strata were omitted and an average of the remainder blow counts were taken for this simplification.

3. τ is an equivalent shear strength for use in the lateral-load response computer program, L-Pile, for a drained strength (S) condition in a cohesive soil. The first and second τ listed for a given layer are values calculated for the top and bottom of that layer, respectively.

4. These numbers refer to the internal types of soil that were specified for the L-Pile computer program analysis for pile response to lateral load. See table ____ for the list of these soil types.

5. K refers to the soil-modulus parameter for *static* loading for use in the L-Pile computer program analysis for pile response to lateral load.

6. This strata was a weathered limestone formation that classified as CL, SP, SC and CH from top to bottom. The material was treated like a stiff clay in the L-Pile analysis and given a modulus of 2,000 pci to be conservative.



G1 G2 G3

N

SCALE

150' 0' 300'

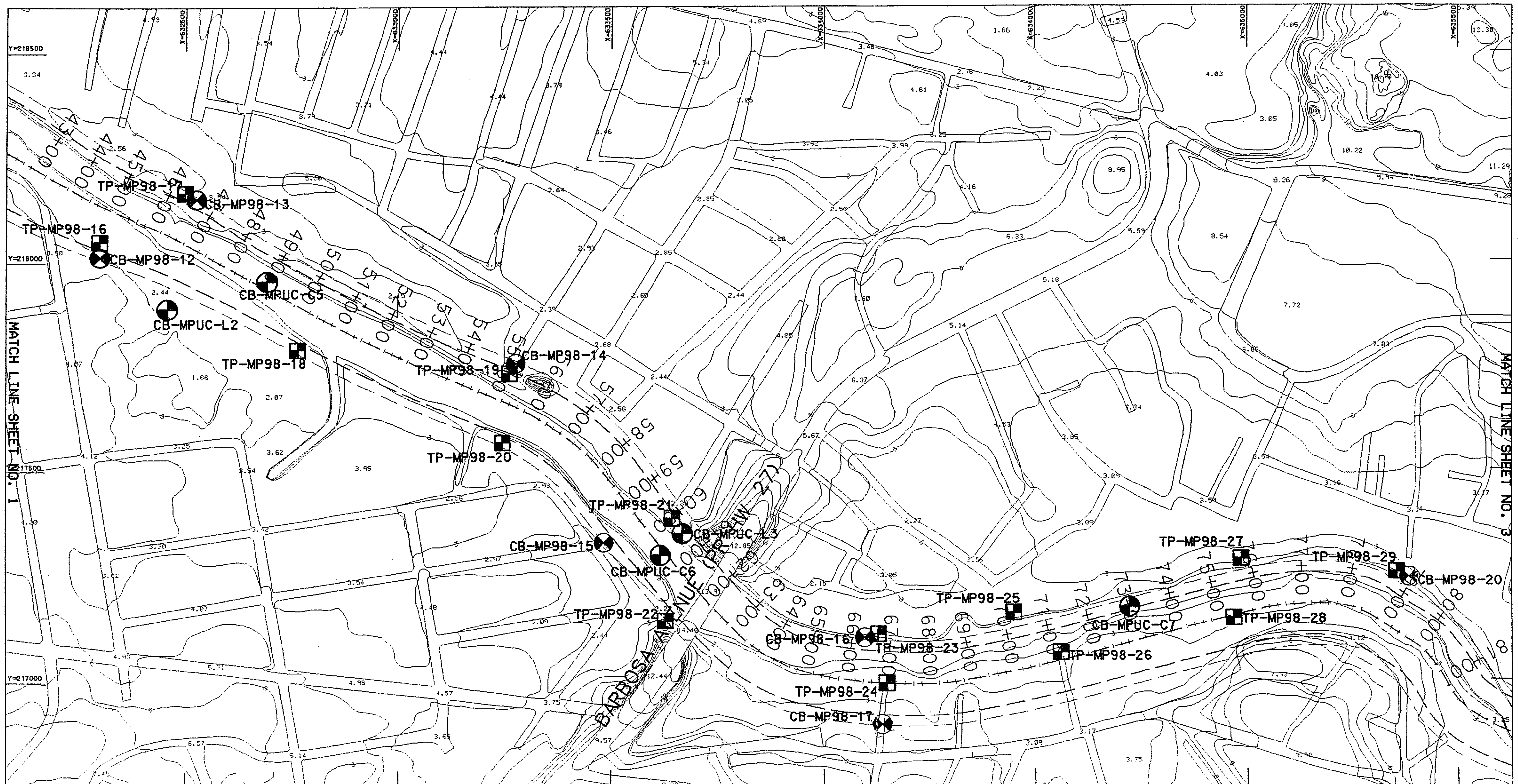
US Army Corps of Engineers
Jacksonville District

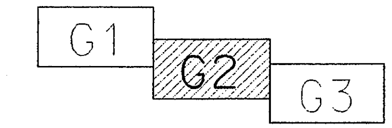
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

Designed by:	Scale: AS SHOWN	
Dwn by:	Ckd by:	
File name: MP98G1.DGN	Reference files: DM11x17.DGN	Plot Date: 22 OCT 1999

MARTIN PENA PROJECT
PUERTO RICO
DETAILED PROJECT REPORT
CORE BORING LOCATION PLAN

PLATE
G1





SCALE

150' 0' 300'

US Army Corps of Engineers
Jacksonville District

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

Designed by: | Dwn by: | Ckd by: | Scale: AS SHOWN

Plot Date: 22 OCT 1999

File name: MP98G2.DGN

Reference files: DM11x17.DGN

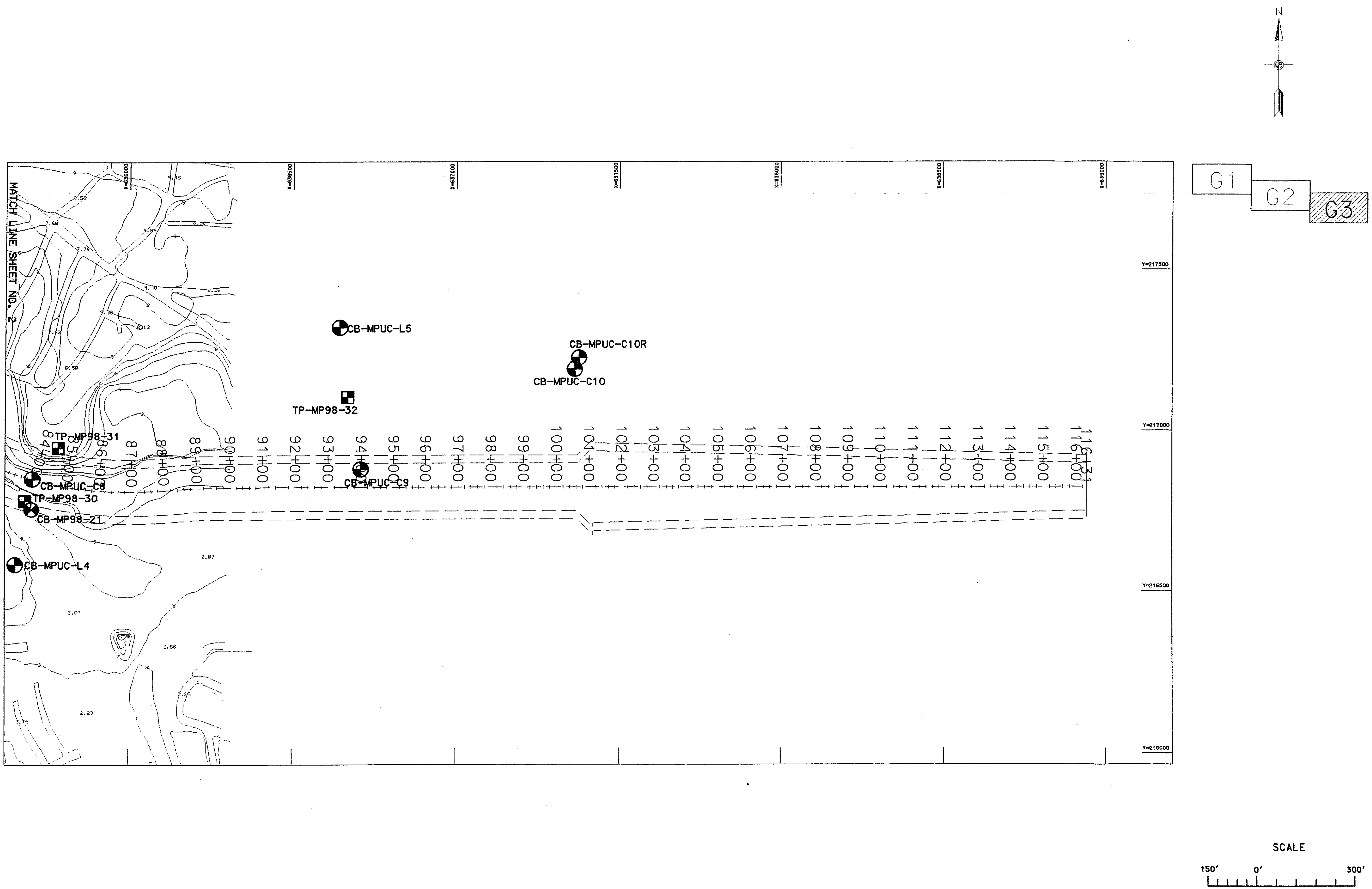
MARTIN PENA PROJECT
PUERTO RICO

DETAILED PROJECT REPORT

CORE BORING LOCATION PLAN

PLATE

G2



US Army Corps of Engineers
Jacksonville District

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

Designed by:
Dwn by: Ckd by:
Plot Date: 22 OCT 1999

Scale: AS SHOWN
Plot date: XX_XX XXXX

File name: MP98G3.DGN
Reference files: DM11x17.DGN

MARTIN PENA PROJECT
PUERTO RICO
DETAILED PROJECT REPORT
CORE BORING LOCATION PLAN

PLATE
G3

DREDGING OF CAÑO MARTÍN PEÑA
PUERTO RICO
FINAL
PROJECT DESIGN REPORT AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX B
GEOTECHNICAL INVESTIGATIONS
BORING LOGS
BY SUELOS, INC.

BORING LOG

SITE ID CB-MPUC-C1

Page 1 of 2 — DATE: 05 FEB 97

CLIENT:	U.S. Army Corps of Engineers	ELEV (GRND)[a]:	-3.9200
SITE NAME:	Martin Pena Canal	NORTHING:	218801.4312
PROJECT NO.:	03886-136-005	EASTING:	629312.9179
CONTRACT NO:	DACW17-95-D-0017 (DO-5)	TOP OF BARGE TO SEDIMENT (ft)	4.30
LOGGED BY:	T. Frinak	TOP OF BARGE TO WATER (ft)	0.75
DRILLING CO:	SUELOS, INC	DEPTH OF WATER (ft)	3.55
RIG TYPE:	XXX CME45 (Barge)	BORING DEPTH (feet msl)	-23.92

Begin Boring: 8:15
End Boring: 1:12
High Tide: 7:18
Low Tide: 13:32

SITE TYPE: Canal (XX) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE 0	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
-3.92	0													
-4.67	0.75													TOP OF WATER
														WATER SAMPLE CB-MPUC-C1 (08:00)
-8.22	4.3	5												TOP OF SEDIMENT No Sample
-8.92	5	6.5	90	W	O	R			SAT	0.5	sulfur	v.soft	2.5Y 2/	OL/OH ORGANIC SILTY CLAY, black organic mud
														DS=Low; D=Rapid; T=Low; P=Low
														Sampled CB-MPUC-C1 08:30
-10.42	6.5	8	80	W	O	R			SAT	0.3	sulfur	v.soft	2.5Y 2/	OL/OH ORGANIC CLAYEY SILT, black organic mud
														Estimated (50%) organics
														DS=Low; D=Rapid; T=Low; P=Low
-11.92	8	9.5	80	W	O	R			SAT	0.2	sulfur	v.soft	2.5Y 2/	OL/OH ORGANIC CLAYEY SILT, black organic mud
														Sample CB-MPUC-C1 09:05
														DS=Low; D=Rapid; T=Low; P=Low
-13.42	9.5	11	75	W	O	R			SAT	0.3	sulfur	v.soft	2.5Y 2/	OL/OH ORGANIC CLAYEY SILT, black organic mud
														used 0.5 feet for CB-MPUC-C1
														DS=Low; D=Rapid; T=Low; P=Low

[a] Elevation of Top of Sediment given in feet from mean sea level.
[b] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.

DS: Dry Strength
D: Dilatancv

BORING LOG

SITE ID CB-MPUC-C1

Page 2 of 2 | DATE: 05 FEB 97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: T. Frinak
DRILLING CO: SUELOS, INC
RIG TYPE: XXX CME45 (Barge)

ELEV (GRND)[a]: -3.9200
NORTHING: 218801.4312
EASTING: 629312.9179
TOP OF BARGE TO SEDIMENT (ft): 4.30
TOP OF BARGE TO WATER (ft): 0.75
DEPTH OF WATER (ft): 3.55
BORING DEPTH (feet msl): -23.92

Begin Boring: 8:15
End Boring: 1:12
High Tide: 7:18
Low Tide: 13:32

SITE TYPE: Canal (XX) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
-14.91	11	12.5	80	W	O	R			SAT	0.4	sulfur	v.soft	2.5Y 2/	OL/OH ORGANIC CLAYEY SILT, black organic mud,
														DS=Low; D=Rapid; T=Low; P=Low
-16.41	12.5	14	100	W	O	R								Sample CB-MPUC-C1 09:45
									WET	0.3	none	soft	5Y 5/4	CL/ML SILTY CLAY, olive with 10% organics
														DS=Medium; D=Slow; T=Medium; P=Medium
-17.91	14	15.5	60	W	O	R			WET	0.2	none	soft	5Y 5/4	CL/ML SILTY CLAY, olive with 10% organics
														DS=Medium; D=Slow; T=Medium; P=Medium
-19.41	15.5	17	75	W	O	R			WET	0.2	none	soft	5Y 5/4	15-16.7: As above.
														16.7-17: SANDY PEAT (90%) Organics, plastic debris
-20.91	17	18.5	80	W	O	R			WET	0.2	none	soft	5Y 5/4	CL/ML SILTY CLAY, olive with interbeds of black sandy peat
													2.5Y 2/	
-22.41	18.5	20	40	W	O	R			WET	0.1	none	soft	5Y 5/4	18.5-19.5: Interbedded SANDY PEAT AND CLAY
													2.5Y 2/	
														19.5-20: OL/OH ORGANIC SAND, cg to mg quartz sand,
														30% organics
														BORING TERMINATED

[a]Elevation of Top of Sediment given in feet from mean sea level.
[b] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm

DS: Dry Strength
D: Dilatency

BORING LOG

SITE ID CB-MPUC-C2

DATE: 5 Feb 97

CLIENT:	U.S. Army Corps of Engineers	ELEV (GRND)[a]:	-2.4800
SITE NAME:	Martin Pena Canal	NORTHING:	218901.6132
PROJECT NO.:	03886-136-005	EASTING:	630315.7806
CONTRACT NO:	DACW17-95-D-0017 (DO-5)	TOP OF BARGE TO SEDIMENT (ft)	4.80
LOGGED BY:	T. Frinak E. Hood	TOP OF BARGE TO WATER (ft)	2.00
DRILLING CO:	SUELOS, INC	DEPTH OF WATER (ft)	2.80
RIG TYPE: XXX	CME45 (Barge)	BORING DEPTH (feet msl)	-22.98

Begin Boring: 12:30
End Boring: 14:45
High Tide: 7:18
Low Tide: 13:32

SITE TYPE: Canal (xx) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE 0	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
-2.48														TOP OF BARGE
-4.48	2													TOP OF WATER
														TOP OF SEDIMENT
-7.28	4.8	5.5	40	W	O	R			WET	3	none	loose	2.5Y 2/	**OL/OH** ORGANIC SAND, black f.g. to m.g. quartz sand and
														shell debris. Fines primarily organic.
-7.98	5.5	7	40	W	O	R			WET	2	none	loose	2.5Y 2/	**OL/OH** ORGANIC SAND, As above
-9.48	7	8.5	60	W	O	R			WET	3	petroleum	loose	2.5Y 2/	7-7.5: ORGANIC SAND, As above
											?		5Y 4/1	7.5-8.5: **CL/ML** CLAY TO SILTY CLAY, gray
														DS=High; D=None-Slow; T=Medium; P=High
-10.98	8.5	10	100	W	O	H			WET	ND	sulfur	soft	5Y 4/1	**CL/ML** SILTY CLAY, gray with abundant wood and
														a bottle cap
														DS=Medium; D=Slow; T=Medium; P=Medium
-12.48	10	11.5	50	W	O	H			WET	ND	sulfur	v. soft	5Y 4/1	**CL/ML** SILTY CLAY, gray with black streaks due to organic-
													2.5Y 2/	rich laminae (thin interbeds)

[a]Elevation of Top of Sediment given in feet from mean sea level.
[b] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.

DS: Dry Strength
D: Dilatancy

BORING LOG

SITE ID: CB-MPUC-C2

Page 2 of 2 DATE: 5 Feb 97

CLIENT:	U.S. Army Corps of Engineers	ELEV (GRND)[a]:	-2.4800
SITE NAME:	Martin Pena Canal	NORTHING:	218901.6132
PROJECT NO.:	03886-136-005	EASTING:	630315.7806
CONTRACT NO:	DACW17-95-D-0017 (DO-5)	TOP OF BARGE TO SEDIMENT (ft)	4.80
LOGGED BY:	T. Frinak E. Hood	TOP OF BARGE TO WATER (ft)	2.00
DRILLING CO:	SUELOS, INC	DEPTH OF WATER (ft)	2.80
RIG TYPE: XXX	CME45 (Barge)	BORING DEPTH (feet msl)	-22.98

Begin Boring: 12:30
End Boring: 14:45
High Tide: 7:18
Low Tide: 13:32

SITE TYPE: Canal (xx) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE 11	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
-13.98	11.5	13	0	WH	3	6	9		NA			NA	NA	No Recovery. Cuttings indicated sand and gravel
-15.48	13	14.5	30	4	3	5	8		DMP	ND	none	firm	5Y 7/1	CH CLAY, gray, very firm with some m.g. quartz sand DS=High; D=None; T=Medium; P=High-Medium
-16.98	14.5	16	40	3	5	8	13		DMP	ND	none	firm	5Y 7/1	CH CLAY, As above
-18.48	16	17.5	40	9	10	13	23		DMP	ND	none	firm	5Y 7/1	CH CLAY, As above
-19.98	17.5	19	50	5	9	11	20		DMP	ND	none	firm	5Y 7/1	CH CLAY, As above
-21.48	19	20.5	50	10	13	18	31		DMP	ND	none	firm	5Y 7/1	CH CLAY, As above BORING TERMINATED @ 20.5

[a]Elevation of Top of Sediment given in feet from mean sea level.

[b]Photo-ionizing Detector Monitoring Data given in relative units ...

DS: Dry Strength

BORING LOG

SITE ID: CB-MPUC-C3

 DATE: 6 Feb 97

CLIENT:	U.S. Army Corps of Engineers	ELEV (GRND)[a]:	0.7400
SITE NAME:	Martin Pena Canal	NORTHING:	217990.0000
PROJECT NO.:	03886-136-005	EASTING:	630797.0000
CONTRACT NO:	DACW17-95-D-0017 (DO-5)	TOP OF BARGE TO SEDIMENT (ft)	6.20
LOGGED BY:	T. Frinak	TOP OF BARGE TO WATER (ft)	1.70
DRILLING CO:	SUELOS, INC	DEPTH OF WATER (ft)	4.50
RIG TYPE: XX	TRIPOD (Barge)	BORING DEPTH (feet msl)	-20.26

Begin Boring: 11:40
End Boring: 12:30
High Tide: 7:18
Low Tide: 12:00

SITE TYPE: Canal (XX) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE 0	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
-1.42														TOP OF BARGE
-3.12	1.7													TOP OF WATER
														TOP OF SEDIMENT
-7.42	6	7.5	20	W	O	R			WET	0	none	loose	2.5Y 2/	PT ORGANIC PEAT, with abundant debris (wire, cloth, shells)
-8.92	7.5	9	0	W	O	R			WET	NA	NA	NA	NA	No recovery
-10.42	9	10.5	0	W	O	R			NA	NA	NA	NA	NA	Hit refusal. Debris in spoon included concrete and wood. Pulled up and offset boring approximately five feet to south No sample collected

[a]Elevation of Top of Sediment given in feet from mean sea level.
[b]Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[c]Color based on the Munsel Soil Color Chart

DS: Dry Strength
D: Dilatancy
T: Toughness
P: Plasticity

BORING LOG

SITE ID CB-MPUC-C3

DATE: 6 Feb 97

CLIENT:	U.S. Army Corps of Engineers	ELEV (GRND)[a]:	0.7400
SITE NAME:	Martin Pena Canal	NORTHING:	217990.0000
PROJECT NO.:	03886-136-005	EASTING:	630797.0000
CONTRACT NO:	DACW17-95-D-0017 (DO-5)	TOP OF BARGE TO SEDIMENT (ft)	6.20
LOGGED BY:	T. Frinak	TOP OF BARGE TO WATER (ft)	1.70
DRILLING CO:	SUELOS, INC	DEPTH OF WATER (ft)	4.50
RIG TYPE: XX	TRIPOD (Barge)	BORING DEPTH (feet msl)	-20.26

Begin Boring:	11:40
End Boring:	12:30
High Tide:	7:18
Low Tide:	12:00

SITE TYPE: Canal (XX) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
-10.42	9	10.5	30	4	1	6	7		DMP	0.2	none	firm	2.5Y 5/	CL/ML CLAYEY SILT, mottled gray and olive brown
													2.5Y 7/	DS=Low; D=Slow; T=Medium; P=Medium
														Beginning of offset boring
-11.92	10.5	12	40	7	10	13	23		DMP	0.1	none	firm	2.5Y 5/	CL/ML CLAYEY SILT, As above
													2.5Y 7/	DS=Low; D=Slow; T=Medium; P=Medium
-13.42	12	13.5	60	9	12	20	22		DMP	0	none	firm	10YR5/	CL/ML CLAYEY SILT, As above
														DS=Low; D=Slow; T=Medium; P=Medium
-14.92	13.5	15	75	12	11	20	31		DMP	0	none	firm	10YR5/	ML SANDY SILT, mottled yellow brown to gray
													2.5Y 7/	DS=Low; D=Slow; T=Low-Medium; P=Medium-low
-16.42	15	16.5	60	4	4	7	11		DMP	0	none	firm	10YR5/	SM CLAYEY SILTY SAND, light gray and yellowish
													2.5Y 7/	brown mottling
-17.92	16.5	18	80	11	12	19	31		MST	0	none	soft	10YR5/	SM CLAYEY SILTY SAND, As above
													2.5Y 7/2	
-19.42	18	19.5	75	11	13	18	31		MST	0	none	soft	10YR5/	ML CLAYEY SANDY SILT, yellowish brown and gray
													2.5Y 7/	DS=Low; D=Slow; T=Low - Medium; P=Medium-low
-20.92	19.5	21	60	21	24	27	51		MST	0	none	firm	2.5Y 4/	ML CLAYEY SANDY SILT, As above
														BORING TERMINATED @ 21

[a] Elevation of Top of Sediment given in feet from mean sea level.

[b] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.

DS: Dry Strength

D: Dilatancy

BORING LOG

SITE ID CB-MPUC-C4

 DATE: 7 Feb 97

CLIENT:	U.S. Army Corps of Engineers
SITE NAME:	Martin Pena Canal
PROJECT NO.:	03886-136-005
CONTRACT NO:	DACW17-95-D-0017 (DO-5)
LOGGED BY:	T. Frinak E. Hood
DRILLING CO:	SUELOS, INC
RIG TYPE:	XX TRIPOD (Barge)

ELEV (GRND)[a]:	-0.6400
NORTHING:	218217.6218
EASTING:	631417.0985
TOP OF BARGE TO SEDIMENT (ft)	5.20
TOP OF BARGE TO WATER (ft)	1.60
DEPTH OF WATER (ft)	3.60
BORING DEPTH (feet msl)	-20.64

Begin Boring:	8:10
End Boring:	10:00
High Tide:	8:15
Low Tide:	11:22

SITE TYPE: Canal (XX) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE 0	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
-0.64														
-2.24	1.6													TOP OF WATER
														TOP OF SEDIMENT
-5.64	5	6.5	40	W	O	R			SAT	4.2	sulfur	v.soft	7.5YR 2/	**OL/OH** ORGANIC CLAY, black organic mud, mucky DS=Low; D=Rapid; T=Low; P=Low
-7.14	6.5	8	100	W	O	R			SAT	1.8	sulfur	v.soft	7.5YR 2/	**OL/OH** ORGANIC CLAY, As above DS=Low; D=Rapid; T=Low; P=Low
-8.64	8	9.5	100	W	O	R			WET	1	sulfur	v.soft	7.5YR 2/	**OL/OH** ORGANIC CLAY, As above DS=Low; D=Rapid; T=Low; P=Low
-10.14	9.5	11	20	W	O	R			WET	0	sulfur		7.5YR 2/	**OL/OH** ORGANIC SAND, Black sand with an organic clay matrix, sand m.g. quartz DS=Low; D=Rapid; T=Low; P=Low

[a]Elevation of Top of Sediment given in feet from mean sea level.
[b] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[c]Color based on the Munsel Soil Color Chart

DS: Dry Strength
D: Dilatancy

BORING LOG

SITE ID: CB-MPUC-C4

Page 2 of 2 | DATE: 7 Feb 97

CLIENT:	U.S. Army Corps of Engineers
SITE NAME:	Martin Pena Canal
PROJECT NO.:	03886-136-005
CONTRACT NO:	DACW17-95-D-0017 (DO-5)
LOGGED BY:	T. Frinak E. Hood
DRILLING CO:	SUELOS, INC
RIG TYPE:	XX TRIPOD (Barge)

ELEV (GRND)[a]:	-0.6400
NORTHING:	218217.6218
EASTING:	631417.0985
TOP OF BARGE TO SEDIMENT (ft)	5.20
TOP OF BARGE TO WATER (ft)	1.60
DEPTH OF WATER (ft)	3.60
BORING DEPTH (feet msl)	-20.64

Begin Boring:	8:10
End Boring:	10:00
High Tide:	8:15
Low Tide:	11:22

SITE TYPE: Canal (XX) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
-11.64	11	12.5	60	WR	2	2	4		WET	0	none	soft	5Y 3/1	SC CLAYEY SAND, Olive brown to gray m.g. sand, organic matrix; sand rounded to subrounded quartz
-13.14	12.5	14	50	2	4	4	8		WET	0	none	soft	10YR 5/4	SC CLAYEY SAND, yellowish brown, m.g. quartz
-14.64	14	15.5	60	12	16	28	44		WET	0	none	soft	2.5YR 3/3	ML SANDY CLAYEY SILT, Reddish brown with gray streaks DS=Low; D=Slow; T=Low-Medium; P=Medium-Low
-16.14	15.5	17	50	10	16	27	43		DMP	0	none	firm	2.5YR 3/3 2.5YR 3/	ML CLAYEY SILT, reddish brown to gray DS=Low; D=Slow; T=Low-Medium; P=Medium-Low
-17.64	17	18.5	60	24	34	47	81		MST	0	none	firm	2.5YR 3/3 2.5YR 3/	CL/ML SILTY CLAY, Reddish brown to gray DS=Medium; D=Slow; T=Medium; P=Medium
-19.14	18.5	20	75	32	46	35	81		DMP	0	none	firm	2.5YR 3/3	CL/ML SANDY SILTY CLAY, Reddish brown to gray DS=Medium; D=Slow; T=Medium; P=Medium BORING TERMINATED @ 20

[a] Elevation of Top of Sediment given in feet from mean sea level.
[b] Photo ionizing Detector ...

DS: Dry Strength

BORING LOG

SITE ID CB-MPUC-C5

 DATE: 6 Feb 97

CLIENT:	U.S. Army Corps of Engineers	ELEV (GRND)[a]:	0.9000
SITE NAME:	Martin Pena Canal	NORTHING:	217956.0000
PROJECT NO.:	03886-136-005	EASTING:	632692.0000
CONTRACT NO:	DACW17-95-D-0017 (DO-5)	TOP OF BARGE TO SEDIMENT (ft)	6.00
LOGGED BY:	T. Frinak	TOP OF BARGE TO WATER (ft)	1.50
DRILLING CO:	SUELOS, INC	DEPTH OF WATER (ft)	4.50
RIG TYPE:	XX TRIPOD (Barge)	BORING DEPTH (feet msl)	-20.10

Begin Boring:	13:30
End Boring:	16:10
High Tide:	7:18
Low Tide:	12:00

SITE TYPE: Canal (XX) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE 0	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
-1.87														TOP OF BARGE
-3.37	1.5													TOP OF WATER
														TOP OF SEDIMENT
-7.87	6	7.5	50	W	O	R			SAT	2.2	none	v.soft	2.5Y 2/	**OL/OH** ORGANIC SILTY CLAY, black organic mud, mucky
														DS=Low; D=Rapid; T=Low; P=Low
-9.37	7.5	9	80	W	O	R			SAT	1	sulfur	v.soft	2.5Y 2/	**OL/OH** ORGANIC SILTY CLAY, As above
														DS=Low; D=Rapid; T=Low; P=Low
-10.87	9	10.5	0	W	O	R			NA	NA	NA	NA	NA	NO RECOVERY
														Cuttings appear to be as above
-12.37	10.5	12	0	W	O	R			NA	NA	NA	NA	NA	NO RECOVERY

[a]Elevation of Top of Sediment given in feet from mean sea level.
[b]Photo-ionizing Detector Monitoring Data given in relative units approximating ppm
[c]Color based on the Munsel Soil Color Chart

DS: Dry Strength
D: Dilatancy
T: Toughness
P: Plasticity

BORING LOG

SITE ID CB-MPUC-C5

DATE: 6-Feb-97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: T. Frinak
DRILLING CO: SUELOS, INC
RIG TYPE: XX TRIPOD (Barge)

ELEV (GRND)[a]: 0.9000
NORTHING: 217956.0000
EASTING: 632692.0000
TOP OF BARGE TO SEDIMENT (ft): 6.00
TOP OF BARGE TO WATER (ft): 1.50
DEPTH OF WATER (ft): 4.50
BORING DEPTH (feet msl): -20.10

Begin Boring: 13:30
End Boring: 16:10
High Tide: 7:18
Low Tide: 12:00

SITE TYPE: Canal (XX) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
-13.87	12	13.5	20	W	O	R			WET	ND	decay	v.soft	2.5Y 3/2	**PT** ORGANIC SAND TO COARSE PEAT, Interbeds of organic-rich sand and peat (95% organics)
-15.37	13.5	15	100	W	O	R			WET	ND	decay	v.soft	2.5Y 3/2	**PT** PEAT, coarse 14.8-15, CLAY, gray brown
-16.87	15	16.5	100	W	O	R			WET	ND	none	v.soft	2.5Y 5/4	**CL/ML** SILTY CLAY, olive brown DS=Medium; D=Slow; T=Medium; P=Medium
-18.37	16.5	18	50	W	O	R			WET	ND	none	v. soft	2.5Y 7/ 2.5Y 5/4	**CL/ML** SILTY CLAY, gray to olive brown with organic laminae DS=Medium; D=Slow; T=Medium; P=Medium
-19.87	18	19.5	60	2	4	7	11		DMP	ND	none	soft	2.5Y 7/	**CL/ML** SILTY CLAY, As above DS=Medium; D=Slow; T=Medium; P=Medium
-21.37	19.5	21	30	7	11	16	27		DMP	ND	none	firm	5YR 3/2	**CL/ML** SILTY CLAY, red brown with gray streaks BORING TERMINATED DS=Medium; D=Slow; T=Medium; P=Medium

[a]Elevation of Top of Sediment given in feet from mean sea level.
[b] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[c]Color based on the Munsel Soil Color Chart

DS: Dry Strength
D: Dilatancy
T: Toughness

BORING LOG

SITE ID CB-MPUC-C6

DATE: 7 Feb 97

CLIENT:	U.S. Army Corps of Engineers
SITE NAME:	Martin Pena Canal
PROJECT NO.:	03886-136-005
CONTRACT NO:	DACW17-95-D-0017 (DO-5)
LOGGED BY:	T. Frinak
DRILLING CO:	SUELOS, INC
RIG TYPE:	XX TRIPOD (Barge)

ELEV (GRND)[a]:	-6.1100
NORTHING:	217297.5577
EASTING:	633617.1282
TOP OF BARGE TO SEDIMENT (ft)	5.20
TOP OF BARGE TO WATER (ft)	1.60
DEPTH OF WATER (ft)	3.60
BORING DEPTH (feet msl)	-26.11

Begin Boring:	13:30
End Boring:	16:10
High Tide:	8:15
Low Tide:	11:22

SITE TYPE: Canal (XX) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			DEPTH 0	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
-6.11														TOP OF BARGE
-7.71	1.6													TOP OF WATER
														Water Sample CB-MPUC-C6 (13:00)
-11.31	5.2	6.5	100	W	O	R			WET	1	sulfur	loose	2.5Y 2/	TOP OF SEDIMENT **OL/OH** ORGANIC CLAY, organic mud with abundant plant material Sampled: CB-MPUC-C6-01 (13:30) DS=Low; D=Rapid; T=Low; P=Low
-12.61	6.5	8	100	W	O	R			WET	1	sulfur	loose	2.5Y 2/	**OL/OH** ORGANIC CLAY, Black organic mud, mucky with plant material DS=Low; D=Rapid; T=Low; P=Low
-14.11	8	9.5	0	W	O	R								NO RECOVERY
-15.61	9.5	11	60	W	O	R			WET	0.3	sulfur	soft	2.5Y 3/3	ORGANIC CLAYEY SAND, Olive clayey sand with shell clasts, Sampled CB-MPUC-C6-02 (15:00)

[a]Elevation of Top of Sediment given in feet from mean sea level.
[b] Photo-Ionizing Detector Monitoring Data given in relative units approximating ppm

DS: Dry Strength

BORING LOG

SITE ID CB-MPUC-C6

Page 2 of 2 | DATE: 7 Feb 97

CLIENT:	U.S. Army Corps of Engineers
SITE NAME:	Martin Pena Canal
PROJECT NO.:	03886-136-005
CONTRACT NO:	DACW17-95-D-0017 (DO-5)
LOGGED BY:	T. Frinak
DRILLING CO:	SUELOS, INC
RIG TYPE:	XX TRIPOD (Barge)

ELEV (GRND)[a]:	-6.1100
NORTHING:	217297.5577
EASTING:	633617.1282
TOP OF BARGE TO SEDIMENT (ft)	5.20
TOP OF BARGE TO WATER (ft)	1.60
DEPTH OF WATER (ft)	3.60
BORING DEPTH (feet msl)	-26.11

Begin Boring:	13:30
End Boring:	16:10
High Tide:	8:15
Low Tide:	11:22

SITE TYPE: Canal (XX) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
-17.11	11	12.5	70	3	1	3	4		WET	0.2	none	soft	2.5Y 3/3	SC CLAYEY SAND, Olive brown clayey sand, decreasing organics with shell clasts.
-18.61	12.5	14	0	2	3	4	7							NO RECOVERY Cuttings suggest soil as above
-20.11	14	15.5	100	2	3	3	6		WET	0	none	soft	2.5Y 4/ 2.5Y 4/3	SC CLAYEY SAND, Gray to olive brown clayey sand with some gravel (shells), Sample CB-MPUC-C6-03 (15:35)
-21.61	15.5	17	65	2	5	6	11		WET	0	none	soft	2.5Y 4/	SC CLAYEY SAND, Gray to olive brown clayey sand
-23.11	17	18.5	70	8	13	26	39		WET	0	none	firm	2.5Y 6/	SC CLAYEY SAND, Gray clayey sand, firm
-24.61	18.5	20	60	15	28	60/4"	88+		MST	0	none	v.firm	2.5Y 6/	SC CLAYEY SAND, Gray, very firm
														BORING TERMINATED @ 20

[a]Elevation of Top of Sediment given in feet from mean sea level.

[b] Photo-ionizing Detector Monitoring Data given in relative units ...

DS: Dry Strength

BORING LOG

SITE ID CB-MPUC-C7

Page 1 of 2 DATE: 13 Feb 97

CLIENT:	U.S. Army Corps of Engineers	ELEV (GRND)[a]:	1.0000
SITE NAME:	Martin Pena Canal	NORTHING:	217166.0000
PROJECT NO.:	03886-136-005	EASTING:	634724.0000
CONTRACT NO:	DACW17-95-D-0017 (DO-5)	TOP OF BARGE TO SEDIMENT (ft)	6.00
LOGGED BY:	T. Frinak	TOP OF BARGE TO WATER (ft)	1.60
DRILLING CO:	SUELOS, INC	DEPTH OF WATER (ft)	4.40
RIG TYPE: XX	TRIPOD (Barge)	BORING DEPTH (feet msl)	-12.50

Begin Boring:	13:30
End Boring:	15:15
High Tide:	13:30
Low Tide:	7:55

SITE TYPE: Canal (XX) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE 0	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
-2.23														TOP OF BARGE
-3.83	1.6													TOP OF WATER
-8.23	6	7.5	50	W	O	R			SAT	1.2	none	v.soft	2.5Y 2/ 5Y 5/3	TOP OF SEDIMENT **OL/OH** ORGANIC CLAY, black organic mud, mucky 7.3-7.5, SANDY CLAY, olive DS=Low; D=Slow; T=Medium; P=Medium to Low
-9.73	7.5	9	15	11	16	13	29		WET	0	none	firm	2.5Y6/2 5YR 4/4	**SC** CLAYEY SAND TO SAND, reddish brown to light brownish gray
-11.23	9	10.5	70	36	65/6				DRY	0	none	v.firm	2.5YR 5/6	**CL/ML** SANDY SILT, red to gray, crumbly texture, very stiff DS=Low; D=None to Slow; T=Medium to High; P=Medium

[a] Elevation of Top of Sediment given in feet from mean sea level.

[b] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.

[c] Color based on the Munsel Soil Color Chart

DS: Dry Strength
D: Dilatancy
T: Toughness

BORING LOG

SITE ID: CB-MPUC-C7

Page 2 of 2 — DATE: 13 Feb 97

CLIENT:	U.S. Army Corps of Engineers
SITE NAME:	Martin Pena Canal
PROJECT NO.:	03886-136-005
CONTRACT NO:	DACW17-95-D-0017 (DO-5)
LOGGED BY:	T. Frinak
DRILLING CO:	SUELOS, INC
RIG TYPE:	XX TRIPOD (Barge)

ELEV (GRND)[a]:	1.0000
NORTHING:	217166.0000
EASTING:	634724.0000
TOP OF BARGE TO SEDIMENT (ft)	6.00
TOP OF BARGE TO WATER (ft)	1.60
DEPTH OF WATER (ft)	4.40
BORING DEPTH (feet msl)	-12.50

Begin Boring:	13:30
End Boring:	15:15
High Tide:	13:30
Low Tide:	7:55

SITE TYPE: Canal (XX) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
-12.73	**10.5**	**12**	34	31	60/6				DRY	0	none	v.firm	10YR 8/	**ML** SANDY SILT, reddish brown to yellow brown
													10YR 6/6	very stiff
														DS=Low; D=None to Slow; T=Medium to High; P=Medium
-14.23	**12**	**13.5**	34	55	80/2				DRY	0	none	v.firm	10YR 6/6	**ML** CLAYEY SILT, red to brownish yellow, very stiff
														DS=Low; D=None to Slow; T=Medium to High; P=Medium
														Due to the inability of the rig to collect
														samples at this location, the boring was terminated.
														Unable to get a larger rig to this location.

[a]Elevation of Top of Sediment given in feet from mean sea level.
[b] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[c]Color based on the Munsel Soil Color Chart

DS: Dry Strength
D: Dilatancy
T: Toughness

BORING LOG

SITE ID CB-MPUC-C8

DATE: 13 Feb 97

CLIENT:	U.S. Army Corps of Engineers
SITE NAME:	Martin Pena Canal
PROJECT NO.:	03886-136-005
CONTRACT NO:	DACW17-95-D-0017 (DO-5)
LOGGED BY:	T. Frinak
DRILLING CO:	SUELOS, INC
RIG TYPE: XX	TRIPOD (Barge)

ELEV (GRND)[a]:	0.4700
NORTHING:	216850.0000
EASTING:	635708.0000
TOP OF BARGE TO SEDIMENT (ft)	4.20
TOP OF BARGE TO WATER (ft)	1.80
DEPTH OF WATER (ft)	2.40
BORING DEPTH (feet msl)	-20.03

Begin Boring: 9:00
End Boring: 10:35
High Tide: 13:30
Low Tide: 7:55

SITE TYPE: Canal (XX) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
-1.49							0							TOP OF BARGE
-3.29	1.8													TOP OF WATER
-5.69	4.2	5.5	100	W	O	R			SAT	2.5	Slight Petroleum	v.soft	2.5Y 2/	TOP OF SEDIMENT **OL/OH** ORGANIC SILTY CLAY, black organic mud, mucky DS=Low; D=Rapid; T=Low; P=Low
-6.99	5.5	7	100	W	O	R			SAT	2	Petroleum	v.soft	2.5Y 2/	**OL/OH** ORGANIC SILTY CLAY, As above DS=Low; D=Rapid; T=Low; P=Low
-8.49	7	8.5	100	W	O	R			SAT	0.6	old Petroleum	v.soft	2.5Y 2/	**OL/OH** ORGANIC SILTY CLAY, As Above DS=Low; D=Rapid; T=Low; P=Low
-9.99	8.5	10	60	W	O	R			WET	0.5	none		5Y 4/1	**SC/SM** GRAVELY SAND, dark gray, gravel consists of shell clasts, sand m.g. quartz
-11.49	10	11.5	50	W	O	R			WET	0.3	none		5Y 4/1	**SC/SM** GRAVELY SAND, as above

[a]Elevation of Top of Sediment given in feet from mean sea level.
[b] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[c]Color based on the Munsel Soil Color Chart

DS: Dry Strength
D: Dilatancy
T: Toughness

BORING LOG

SITE ID CB-MPUC-C8

DATE: 13 Feb 97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: T. Frinak
DRILLING CO: SUELOS, INC
RIG TYPE: XX TRIPOD (Barge)

ELEV (GRND)[a]: 0.4700
NORTHING: 216850.0000
EASTING: 635708.0000
TOP OF BARGE TO SEDIMENT (ft) 4.20
TOP OF BARGE TO WATER (ft) 1.80
DEPTH OF WATER (ft) 2.40
BORING DEPTH (feet msl) -20.03

Begin Boring: 9:00
End Boring: 10:35
High Tide: 13:30
Low Tide: 7:55

SITE TYPE: Canal (XX) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
-12.99	11.5	13	75	W	O	R			WET	0	slight decay	soft	5Y 3/1	**PT** PEATY CLAY, gray (50% organics) DS=Low; D=Rapid; T=Low; P=Nonplastic to low
-14.49	13	14.5	75	W	O	R			WET	0	none	soft	5Y 3/1	13-13.6, **PT** PEATY CLAY, as above 13.6-14.5, **SC/SM** GRAVELY SAND, shell gravel
-15.99	14.5	16	60	W	O	R			WET	0	none	soft	2.5Y 4/	14.5-15.8, **PT** CLAYEY PEAT 15.8-16, **CL/ML** SILTY CLAY, gray DS=Medium; D=Slow; T=Medium; P=Medium to High
-17.49	16	17.5	50	W	O	R			WET	0	none	soft	2.5Y 5/2	**CL** CLAY TO SANDY CLAY, 10% organics, quartz sand, m.g., subrounded to rounded DS=Medium; D=Slow; T=Medium; P=Medium to High
-18.99	17.5	19	75	W	O	R			WET	0	none	soft	2.5Y 5/3	**SC/SM** GRAVELY CLAYEY SAND, olive brown with 10% organics, gravel appears to be carbonate cemented sand, m.g. to c.g. rounded (ooids?)
-20.49	19	20.5	85	6	8	13	21		WET	0	none	firm	2.5Y 5/3	**CL/ML** SILTY SANDY CLAY, mottled yellow brown, gray, and olive brown DS=Medium to Low; D=Slow; T=Medium; P=Medium

[a]Elevation of Top of Sediment given in feet from mean sea level.
[b] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[c]Color based on the Munsel Soil Color Chart

DS: Dry Strength
D: Dilatancy
T: Toughness

BORING LOG

CLIENT:	U.S. Army Corps of Engineers	ELEV (GRND)[a]:	-2.0100
SITE NAME:	Martin Pena Canal	NORTHING:	216879.7416
PROJECT NO.:	03886-136-005	EASTING:	636708.2841
CONTRACT NO:	DACW17-95-D-0017 (DO-5)	TOP OF BARGE TO SEDIMENT (ft)	4.10
LOGGED BY:	T. Frinak	TOP OF BARGE TO WATER (ft)	1.10
DRILLING CO:	SUELOS, INC	DEPTH OF WATER (ft)	3.00
RIG TYPE: XX	TRIPOD (Barge)	BORING DEPTH (feet msl)	-23.01

SITE ID CB-MPUC-C9

Page 1 of 2 DATE: 11 Feb 97

Begin Boring:	14:00
End Boring:	15:40
High Tide:	11:54
Low Tide:	5:43

SITE TYPE: Canal (XX) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
							0							
-2.01														TOP OF BARGE
-3.11	1.1													TOP OF WATER
-6.11	4.1	4.5												
-6.51	4.5	6	100	W	O	R			SAT	0	none	v.soft	2.5Y 2/	TOP OF SEDIMENT No Sample Collected **OL/OH** ORGANIC SILTY CLAY, black organic, peaty with shell clasts DS=Low; D=Slow to Rapid; T=Low; P=Low
-8.01	6	7.5	90	W	O	R			SAT	0.8	decay	v.soft	5Y 3/1	**PT** CLAYEY PEAT, very dark gray, 75% organic with shell clasts
-9.51	7.5	9	100	W	O	R			SAT	1	decay	v.soft	5Y 3/1	**PT** CLAYEY PEAT, As above
-11.01	9	10.5	100	W	O	R			SAT	1	decay	v.soft	5Y 3/1	**PT** CLAYEY PEAT, As above
-12.51	10.5	12	100	W	O	R			SAT	1	decay	v.soft	5Y 3/1	10.1-10.5, COARSE PEAT **PT** COARSE PEAT

[a]Elevation of Top of Sediment given in feet from mean sea level.

[b] Photo-ionizing Detector Monitoring Data given in relative units ...

DS: Dry Strength

BORING LOG

SITE ID CB-MPUC-C9

Page 2 of 2 DATE: 11 Feb 97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: T. Frinak
DRILLING CO: SUELOS, INC
RIG TYPE: XX TRIPOD (Barge)

ELEV (GRND)[a]: -2.0100
NORTHING: 216879.7416
EASTING: 636708.2841
TOP OF BARGE TO SEDIMENT (ft) 4.10
TOP OF BARGE TO WATER (ft) 1.10
DEPTH OF WATER (ft) 3.00
BORING DEPTH (feet msl) -23.01

Begin Boring: 14:00
End Boring: 15:40
High Tide: 11:54
Low Tide: 5:43

SITE TYPE: Canal (XX) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
-14.01	12	13.5	100	W	O	R			WET	0	Slight decay	v.soft	10YR 3/3	PT COARSE PEAT, dark grayish brown
-15.51	13.5	15	100	W	O	R			WET	0	decay	v.soft	10YR 3/3	PT COARSE PEAT, as above
-17.01	15	16.5	0	W	O	R			NA	NA	NA	NA	NA	NO RECOVERY Cuttings indicate peat
-18.51	16.5	18	0	W	O	R			NA	NA	NA	NA	NA	NO RECOVERY Cuttings indicate peat
-20.01	18	19.5	100	W	O	R			WET	0	decay	v.soft	10YR 3/3	PT COASE PEAT TO PEATY CLAY
-21.51	19.5	21	100	W	O	R			WET	0	decay	v.soft	10YR 3/3	PT COARSE PEAT BORING TERMINATED

[a]Elevation of Top of Sediment given in feet from mean sea level.
[b] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm

DS: Dry Strength

BORING LOG

SITE ID CB-MPUC-C10

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CLIENT:	U.S. Army Corps of Engineers	ELEV (GRND)[a]:	-0.9300
SITE NAME:	Martin Pena Canal	NORTHING:	217190.0037
PROJECT NO.:	03886-136-005	EASTING:	637362.6912
CONTRACT NO:	DACW17-95-D-0017 (DO-5)	TOP OF BARGE TO SEDIMENT (ft)	2.60
LOGGED BY:	T. Frinak	TOP OF BARGE TO WATER (ft)	1.40
DRILLING CO:	SUELOS, INC	DEPTH OF WATER (ft)	1.20
RIG TYPE: XX	TRIPOD (Barge)	BORING DEPTH (feet msl)	-21.93

Begin Boring:	9:00
End Boring:	11:20
High Tide:	11:54
Low Tide:	5:43

SITE TYPE: Canal (XX) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE 0	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
-0.93														TOP OF BARGE
-2.13	1.2													TOP OF WATER
														Water Sample CB-MPUC-C10 (09:00)
-3.53	2.6													TOP OF SEDIMENT
-3.53	2.6	4.5	60	W	O	R			SAT	1	none	v.soft	2.5Y 2/	**OL/OH** ORGANIC SILTY CLAY, black organic
														SAMPLE: CB-MPUC-C10-01 (09:30)
														DS=Low; D=Slow; T=Low; P=Low
-5.43	4.5	6	100	W	O	R			SAT	0.5	none	v.soft	2.5Y 2/	**OL/OH** ORGANIC SILTY CLAY, As above
														5.8-6.0 CLAYEY PEAT, black
-6.93	6	7.5	100	W	O	R			SAT	0	none	v.soft	2.5Y 2/	**PT** PEATY CLAY, with interbeds of organic silt
													2.5Y 3/2	SAMPLE: CB-MPUC-C10-02 (09:45)
														DS=Low; D=Rapid; T=Low; P=Low
-8.43	7.5	9	70	W	O	R			SAT	0.3	none	v.soft	2.5Y 3/2	**PT** PEATY CLAY, dark grayish brown with coarse
														organic material
														DS=Low; D=Rapid; T=Low; P=Low
-9.93	9	10.5	80	W	O	R			SAT	0.3	none	v.soft	10YR 3/1	**PT** PEAT, dark brown with interbeds of peaty clay

[a]Elevation of Top of Sediment given in feet from mean sea level.
[b] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.

DS: Dry Strength
D: Dilatancy

BORING LOG

SITE ID: CB-MPUC-C10

DATE: 11 Feb 97

CLIENT:	U.S. Army Corps of Engineers
SITE NAME:	Martin Pena Canal
PROJECT NO.:	03886-136-005
CONTRACT NO:	DACW17-95-D-0017 (DO-5)
LOGGED BY:	T. Frinak
DRILLING CO:	SUELOS, INC
RIG TYPE:	XX TRIPOD (Barge)

ELEV (GRND)[a]:	-0.9300
NORTHING:	217190.0037
EASTING:	637362.6912
TOP OF BARGE TO SEDIMENT (ft)	2.60
TOP OF BARGE TO WATER (ft)	1.40
DEPTH OF WATER (ft)	1.20
BORING DEPTH (feet msl)	-21.93

Begin Boring:	9:00
End Boring:	11:20
High Tide:	11:54
Low Tide:	5:43

SITE TYPE: Canal (XX) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
-11.43	10.5	12	60	W	O	R			WET	1	none	v.soft	10YR 3/1	PT PEATY CLAY, very dark gray, 60 % organics
														some shell clasts
-12.93	12	13.5	70	W	O	R								DS=Low; D=Rapid; T=Low; P=Low
									WET	0	decay	v.soft	2.5Y 3/2	PT COARSE PEAT, very dark gray brown
														Strong decay odor
-14.43	13.5	15	60	W	O	R			WET	1	decay	v.soft	2.5Y 3/2	PT COARSE PEAT, As above
-15.93	15	16.5	70	W	O	R			WET	1	decay	v.soft	2.5Y 3/2	PT COARSE PEAT, As above with plastic debris
-17.43	16.5	18	95	W	O	R			WET	0	decay	v.soft	10YR 2/2	PT COARSE PEAT, very dark brown with shell clasts
-18.93	18	19.5	0	W	O	R			NA	NA	NA	NA	NA	NO RECOVERY
-20.43	19.5	21	100	W	O	R			WET	0	decay	v.soft	10YR 2/2	COARSE PEAT, with interbeds of clayey peat
														BORING TERMINATED

[a]Elevation of Top of Sediment given in feet from mean sea level.

[b] Photo-ionizing Detector Monitoring Data given in relative units approximating ...

DS: Dry Strength

BORING LOG

SITE ID CB-MPUC-C10R

Page 1 of 2 | DATE: 11 Feb 97

CLIENT:	U.S. Army Corps of Engineers	ELEV (GRND)[a]:	-0.8000
SITE NAME:	Martin Pena Canal	NORTHING:	217226.3066
PROJECT NO.:	03886-136-005	EASTING:	637376.2360
CONTRACT NO:	DACW17-95-D-0017 (DO-5)	TOP OF BARGE TO SEDIMENT (ft)	3.00
LOGGED BY:	T. Frinak	TOP OF BARGE TO WATER (ft)	1.10
DRILLING CO:	SUELOS, INC	DEPTH OF WATER (ft)	1.90
RIG TYPE: XX	TRIPOD (Barge)	BORING DEPTH (feet msl)	-21.80

Begin Boring: 12:00
End Boring: 13:15
High Tide: 11:54
Low Tide: 5:43

SITE TYPE: Canal (XX) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE 0	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
-0.8														TOP OF BARGE
-1.9	1.1													
														TOP OF WATER
														Water Sample CB-MPUC-C10 (09:00)
														TOP OF SEDIMENT
-3.8	3	4.5	100	W	O	R			SAT	1	none	v.soft	2.5Y 2/	**OL/OH** ORGANIC SILTY CLAY, mud with shell clasts
														SAMPLE: CB-MPUC-C10R-01 (12:00)
														DS=Low; D=Slow; T=Low; P=Low
-5.3	4.5	6	15	W	O	R			SAT	1	none	v.soft	2.5Y 2/	**OL/OH** ORGANIC SILTY CLAY, As above
														DS=Low; D=Slow; T=Low; P=Low
-6.8	6	7.5	100	W	O	R			SAT	1	none	v.soft	5Y 2.5/1	**OL/OH** ORGANIC SILTY CLAY, black organic
														7.3-7.5 PEATY CLAY
														SAMPLE: CB-MPUC-C10R-02 (12:15)
-8.3	7.5	9	100	W	O	R			SAT	0.5	none	v.soft	5Y 2.5/1	**OL/OH** ORGANIC SILTY CLAY, black organic
														DS=Low; D=Slow; T=Low; P=Low
-9.8	9	10.5	80	W	O	R			SAT	0	none	v.soft	5Y 2.5/1	**PT** PEATY CLAY, black, 70% organics
														SAMPLE: CB-MPUC-C10R-03 (12:35)
														DS=Low; D=Rapid; T=Low; P=Low

[a]Elevation of Top of Sediment given in feet from mean sea level.
[b] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm

DS: Dry Strength

BORING LOG

SITE ID **CB-MPUC-C10R**

 DATE: 11 Feb 97

CLIENT:	U.S. Army Corps of Engineers	ELEV (GRND)[a]:	-0.8000
SITE NAME:	Martin Pena Canal	NORTHING:	217226.3066
PROJECT NO.:	03886-136-005	EASTING:	637376.2360
CONTRACT NO:	DACW17-95-D-0017 (DO-5)	TOP OF BARGE TO SEDIMENT (ft)	3.00
LOGGED BY:	T. Frinak	TOP OF BARGE TO WATER (ft)	1.10
DRILLING CO:	SUELOS, INC	DEPTH OF WATER (ft)	1.90
RIG TYPE: XX	TRIPOD (Barge)	BORING DEPTH (feet msl)	-21.80

Begin Boring: 12:00
End Boring: 13:15
High Tide: 11:54
Low Tide: 5:43

SITE TYPE: Canal (XX) Land ( )

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[b]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[c]	LITHOLOGIC DESCRIPTION
-11.3	10.5	12	100	W	O	R			SAT	0	none	v.soft	5Y 2.5/1	PT COARSE PEAT, black with interbeds of gray
													2.5Y 3/	organic sandy clay
-12.8	12	13.5	100	W	O	R			WET	0	decay	v.soft	5Y 3/1	PT COARSE PEAT, dark gray with interbeds of peaty clay
-14.3	13.5	15	100	W	O	R			WET	0	decay	v.soft	5Y 3/1	PT COARSE PEAT, as above
-15.8	15	16.5	100	WO	R	1	1		WET	0.5	decay	v.soft	5Y 3/1	PT COARSE PEAT
-17.3	16.5	18	100	W	O	R			WET	0	decay	v.soft	10YR 3/2	PT COARSE PEAT, very dark grayish brown
-18.8	18	19.5	50	W	O	R			WET	1	decay	v.soft	10YR 3/2	PT COARSE PEAT, with interbeds of organic clay
-20.3	19.5	21	85	W	O	R			WET	1	decay	v.soft	2.5Y 5/2	PT COARSE PEAT with interbeds of clayey peat
														BORING TERMINATED

[a]Elevation of Top of Sediment given in feet from mean sea level.
[b] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm

DS: Dry Strength

BORING LOG

SITE ID CB-MPUC-L1

 DATE: 5 Feb 97

CLIENT:	U.S. Army Corps of Engineers
SITE NAME:	Martin Pena Canal
PROJECT NO.:	03886-136-005
CONTRACT NO:	DACW17-95-D-0017 (DO-5)
LOGGED BY:	E. Hood
DRILLING CO:	SUELOS, INC
RIG TYPE:	Trailer-mounted Acker 82
ELEV (GRND):	-0.2200
NORTHING:	218386.0775
EASTING:	631326.8540
TOTAL BORING DEPTH (ft bgs):	60.00
DEPTH TO WATER (ft bgs)	3.00
TOTAL DEPTH ELEVATION (ft msl)	-60.22
Begin Boring:	5-Feb-97
End Boring:	7-Feb-97
DRILLING TYPE:	HSA
SITE TYPE:	Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE 0	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
-0.22	0	1.5	60	3	10	11	21	fill	MST	0	none	firm	2.5Y 5/4	CL/ML SILTY CLAY, stiff, plastic, FILL DS=Medium; D=Slow; T=Medium; P=Medium
-1.72	1.5	3	50	5	7	16	23		WET	0	none	soft	5Y 4/4	ML SANDY SILT, olive brown, low plasticity, FILL DS=Low; D=Rapid; T=Low; P=Low
-3.22	3	4.5	30	10	37	3	40		WET	0	none	firm	5Y 3/4	WOOD DEBRIS, FILL
-4.72	4.5	6	55	1	11	1	12	soil	SAT	11	solvent	soft	5Y 2.5/1	OL/OH ORGANIC SILTY CLAY, black with some small roots DS=Low; D=Rapid; T=Low; P=Medium to Low
-6.22	6	7.5	100	1	1	1	2		SAT	65	foul?	soft	5Y 2.5/1	AS ABOVE
-7.72	7.5	9	50	7	3	1	4		SAT	216	foul?	soft	10YR 2/2	AS ABOVE
	9	10.5	100	1	1	1	2		SAT	15	foul?	soft	10YR 4/2	SM SILTY SAND, dark gray, mg.

[a] Photo-Ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart

DS: Dry Strength
D: Dilatancy

BORING LOG

SITE ID: CB-MPUC-L1

DATE: 5 Feb 97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: E. Hood
DRILLING CO: SUELOS, INC
RIG TYPE: Trailer-mounted Acker 82

ELEV (GRND): -0.2200
NORTHING: 218386.0775
EASTING: 631326.8540
TOTAL BORING DEPTH (ft bgs): 60.00
DEPTH TO WATER (ft bgs): 3.00
TOTAL DEPTH ELEVATION (ft msl): -60.22

Begin Boring: 5-Feb-97
End Boring: 7-Feb-97
DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
-10.72	10.5	12	100	5	7	8	15		SAT	20	foul?	firm	10YR 4/2	CL SANDY CLAY, dark gray, stiff
														DS=High to Medium; D=None; T=Medium; P=Medium to High
-12.22	12	13.5	40	3	4	4	8		MST	0	slight	firm	10YR 6/1	CL SANDY CLAY, gray, stiff
														DS=High to Medium; D=None; T=Medium; P=Medium to High
-13.72	13.5	15	50	4	6	11	17		DRY	0	none	v.firm	10YR 6/1	CL SANDY CLAY, Mottled gray, brown, purple, stiff
														DS=High to Medium; D=None; T=Medium; P=Medium to High
-15.22	15	16.5	45	4	6	11	17		DRY	0	none	v.firm	10YR 6/1	AS ABOVE
													10YR 4/3	
-16.72	16.5	18	100	7	14	14	28		DRY	0	none	v.firm	10YR 4/4	CL/ML SILTY CLAY
														DS=High to Medium; D=None; T=Medium; P=Medium to High
-18.22	18	19.5	100	4	8	7	15		MST	0	none	v.firm	10YR 4/4	CL/ML SILTY CLAY, olive brown, plastic
														DS=High to Medium; D=None; T=Medium; P=Medium to High
-19.72	19.5	21	100	7	12	14	26		MST	1.2	none	v.firm	5YR 4/4	CL/ML SILTY CLAY, yellowish red, plastic
														DS=High to Medium; D=None; T=Medium; P=Medium to High
-21.22	21	22.5	44	7	18	18	36		DMP	1	none	v.firm	5Y4 4/4	CL/ML SILTY CLAY, yellowish red
														DS=High to Medium; D=None; T=Medium; P=Medium

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart

DS: Dry Strength

BORING LOG

SITE ID: CB-MPUC-L1

 DATE: 5 Feb 97

CLIENT:	U.S. Army Corps of Engineers	ELEV (GRND):	-0.2200
SITE NAME:	Martin Pena Canal	NORTHING:	218386.0775
PROJECT NO.:	03886-136-005	EASTING:	631326.8540
CONTRACT NO:	DACW17-95-D-0017 (DO-5)	TOTAL BORING DEPTH (ft bgs):	60.00
LOGGED BY:	E. Hood	DEPTH TO WATER (ft bgs)	3.00
DRILLING CO:	SUELOS, INC	TOTAL DEPTH ELEVATION (ft msl)	-60.22
RIG TYPE:	Trailer-mounted Acker 82		

Begin Boring: 5-Feb-97
End Boring: 7-Feb-97
DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
-22.72	22.5	24	40	7	9	13	22		MST	1	none	v.firm	2.5Y 7/1	CH CLAY, stiff, high plasticity
														DS=High; D=None; T=Medium; P=High to Medium
-24.22	24	25.5	100	8	10	20	30		MST	0	none	v.firm	2.5Y 7/1	AS ABOVE
														DS=High; D=None; T=Medium; P=High to Medium
-25.72	25.5	27	100	12	16	20	36		MST	0	none	v.firm	2.5Y 7/1	AS ABOVE
-27.22	27	28.5	100	14	19	30	49		MST	0	none	v.firm	5YR 4/6	CL/ML SILTY CLAY, yellowish red, mottled with olive yellow
														DS=Medium; D=None to Slow; T=Medium; P=Medium
-28.72	28.5	30	100	8	11	27	38		MST	1	none	v.firm	2.5Y 6/6	CL/ML SANDY CLAY
														DS=Medium; D=Slow; T=Medium to Low; P=Low
-30.22	30	31.5	100	14	27	27	54		MST	2	none	v.firm	5YR 4/4	CL/ML SILTY CLAY, reddish brown
														DS=Medium; D=None to Slow; T=Medium; P=Medium
-31.72	31.5	33	100	17	27	43	70		MST	3	none	v.firm	5YR 4/4	ML SANDY CLAYEY SILT, reddish brown
														DS=Medium to Low; D=Slow; T=Medium; P=Medium to Low
-33.22	33	34.5	100	14	19	27	46		MST	0	none	v.firm	5YR 4/6	CL/ML SILTY CLAY, yellowish red
														DS=Medium; D=None to Slow; T=Medium; P=Medium

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart

DS: Dry Strength

BORING LOG

SITE ID CB-MPUC-L1

DATE: 5 Feb 97

Begin Boring: 5-Feb-97
End Boring: 7-Feb-97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: E. Hood
DRILLING CO: SUELOS, INC
RIG TYPE: Trailer-mounted Acker 82

ELEV (GRND): -0.2200
NORTHING: 218386.0775
EASTING: 631326.8540
TOTAL BORING DEPTH (ft bgs): 60.00
DEPTH TO WATER (ft bgs): 3.00
TOTAL DEPTH ELEVATION (ft msl): -60.22

DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
-34.72	34.5	36	100	15	22	24	46		MST	1	none	v.firm	7.5YR 5/8	CL/ML SANDY SILTY CLAY, stiff DS=Medium; D=None to Slow; T=Medium; P=Medium
-36.22	36	37.5	100	20	32	41	73		MST	1	none	v.firm	10YR 4/4	ML SANDY SILT, dark yellowish brown DS=Low; D=Slow; T=Medium; P=Low
-37.72	37.5	39	100	20	20	21	41		DMP	1	none	firm	10YR 5/8	ML SANDY CLAYEY SILT, yellowish brown with thin beds of silty sand DS=Low; D=Slow; T=Medium; P=Medium
-39.22	39	40.5	75	14	17	23	40		DMP	1	none	firm	10YR 5/8	ML CLAYEY SILT, yellowish brown DS=Medium; D=None to Slow; T=Medium; P=Medium
-40.72	40.5	42	100	17	20	27	47		MST	1	none	v.firm	10YR 6/6	CL/ML SILTY CLAY, brownish yellow, mottled, plastic DS=Medium; D=None to Slow; T=Medium; P=Medium
-42.22	42	43.5	100	14	19	27	46		WET	0	none	firm	10YR 7/2	SP SAND, light gray m.g. with clayey sand interbeds
-43.72	43.5	45	33	5	10	18	28		WET	0	none	soft	10YR 6/8	SP SAND, brownish yellow m.g.
-45.22	45	46.5	40	9	19	25	44		MST	0	none	firm	10YR 6/8	ML SANDY CLAYEY SILT, mottled yellowish brown with sand interbeds

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] [illegible]

DS: Dry Strength

BORING LOG

SITE ID CB-MPUC-L1

 DATE: 5 Feb 97

Begin Boring: 5-Feb-97
End Boring: 7-Feb-97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: E. Hood
DRILLING CO: SUELOS, INC
RIG TYPE: Trailer-mounted Acker 82

ELEV (GRND): -0.2200
NORTHING: 218386.0775
EASTING: 631326.8540
TOTAL BORING DEPTH (ft bgs): 60.00
DEPTH TO WATER (ft bgs): 3.00
TOTAL DEPTH ELEVATION (ft msl): -60.22

DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
-46.72	46.5	48	33	9	14	19	33		MST	0	none	firm	10YR 5/6	SC CLAYEY SAND, yellowish brown with clay interbeds
-48.22	48	49.5	33	9	17	23	40		MST	0	none	v.firm	10YR 5/8	CL/ML SILTY SANDY CLAY, yellowish brown, stiff, with sand interbeds DS=Medium; D=None; T=Medium; P=Medium
-49.72	49.5	51	100	11	16	23	39		WET	0	none	soft	10YR 6/2	SP SAND, light brown, m.g. loose to soft
-51.22	51	52.5	57	9	16	21	37		WET	0	none	soft	5Y 7/2	SP SAND, light gray with clay interbeds
-52.72	52.5	54	60	9	14	22	36		WET	0	none	soft	2.5Y 8/6	SP SAND, yellow, m.g., with interbeds of mottled gray/ brown clay
-54.22	54	55.5	100	14	35	50	85		MST	0	none	firm	10YR 5/6	SC SILTY CLAYEY SAND, yellowish brown
-55.72	55.5	57	100	13	21	32	53		DMP	0	none	v.firm	7.5YR 5/8	ML SANDY CLAYEY SILT, strong brown to dark red mottled
-57.22	57	58.5	50	32	60/6				WET	0	none	soft	2.5Y 5/6	SP SAND, light olive brown with clay interbeds
-58.72	58.5	60	50	32	60	50/4	110		WET	0	none	soft	2.5Y 5/6	AS ABOVE, BORING TERMINATED

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart

DS: Dry Strength

BORING LOG

SITE ID CB-MPUC-L2

 DATE: 12 Feb 97

Begin Boring: 12-Feb-97
End Boring: 13-Feb-97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: E. Hood
DRILLING CO: SUELOS, INC
RIG TYPE: Trailer-mounted Acker 82

ELEV (GRND): 0.6200
NORTHING: 217888.7726
EASTING: 632458.9606
TOTAL BORING DEPTH (ft bgs): 60.00
DEPTH TO WATER (ft bgs): 4.00
TOTAL DEPTH ELEVATION (ft msl): -59.38

DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
0.62	0	1.5	50	2	6	13	19	fill	DRY	0	none	soft	7.5YR 4/4	ML SANDY SILT, brown fill with construction debris
														DS=Low; D=Slow to Rapid; T=Low; P=Low to Non
-0.88	1.5	3	75	5	9	5	14		DRY	0	none	soft	7.5YR 4/6	SM SILTY SAND, strong brown, loose, with some gravel
-2.38	3	4.5	75	2	2	2	4		WET	3	none		5.6 4/1	SM GRAVELY SILTY SAND, dark greenish gray to pale olive.
-3.88	4.5	6	44	2	4	2	6		SAT	4	none	soft	2.5Y 4/2	CL/ML GRAVELY SILTY CLAY, dark grayish brown, gravel angular construction debris? (FILL)
														Gravel consists of concrete and carbonate
-5.38	6	7.5	100	2	1	1	2		SAT	0	none		2.5Y 4/2	SM GRAVELY SILTY SAND, As above. FILL
														Horizon to 13.5 consists of gravely fill dirt and construction debris (concrete)
-6.88	7.5	9	44	1	2	1	3		SAT	0	none		2.5Y 4/2	SM GRAVELY SILTY SAND, As above. FILL
-8.38	9	10.5	55	2	1	2	3		SAT	0	none		5Y 4/2	SM GRAVELY SILTY SAND, olive gray, As above, FILL

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart

DS: Dry Strength
D: Dilatancy
T: Toughness

BORING LOG

SITE ID: CB-MPUC-L2

 DATE: 12 Feb 97

Begin Boring: 12-Feb-97
End Boring: 13-Feb-97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: E. Hood
DRILLING CO: SUELOS, INC
RIG TYPE: Trailer-mounted Acker 82

ELEV (GRND): 0.6200
NORTHING: 217888.7726
EASTING: 632458.9606
TOTAL BORING DEPTH (ft bgs): 60.00
DEPTH TO WATER (ft bgs): 4.00
TOTAL DEPTH ELEVATION (ft msl): -59.38

DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
-9.88	10.5	12	100	1	1	1	2	fill	SAT	0	none		5Y 4/2	**SP** SAND, olive gray, loose, locally clayey, FILL
-11.38	12	13.5	80	1	1	3	4		SAT	1	decay	soft	5Y 4/2	**SC** CLAYEY SAND, olive gray with small angular gravel sand f.g. to m.g., FILL
-12.88	13.5	15	100	1	1	1	2	soil	MST	1	decay	soft	5Y 2.5/1	**OL/OH** ORGANIC SILT, black peaty DS=Medium to Low; D=Slow; T=Low; P=Low
-14.38	15	16.5	100						WET	0	none	soft	2.5Y 5/4	**CL/ML** SILTY CLAY, light olive brown, organic DS=Medium; D=Slow to None; T=Medium; P=Medium
-15.88	16.5	18	100		1	1	2		WET	0	none	soft	2.5Y 5/4	**CL/ML** SILTY CLAY, as above DS=Medium; D=Slow to None; T=Medium; P=Medium
-17.38	18	19.5	100	2	1	3	4		MST	0	none	soft	5B 7/1	**CL/ML** SILTY CLAY, light blueish gray, no organics DS=Medium; D=Slow to None; T=Medium; P=Medium
-18.88	19.5	21	66	1	2	3	5		MST	0	none	firm	5B 7/1 10R 4/3	**CL/ML** SILTY CLAY, light blueish gray to red, interbedded silt and silty clay with some f.g. sand interbeds DS=Medium; D=Slow; T=Medium; P=Medium
-20.38	21	22.5	66	4	8	15	23		MST	0	none	firm	10R 4/8	**ML** CLAYEY SANDY SILT, red, as above DS=Low; D=Slow; T=Low-Medium; P=Low

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart

DS: Dry Strength

BORING LOG

SITE ID: CB-MPUC-L2

 DATE: 12Feb97

Begin Boring: 12-Feb-97
End Boring: 13-Feb-97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: E. Hood
DRILLING CO: SUELOS, INC
RIG TYPE: Trailer-mounted Acker 82

ELEV (GRND): 0.6200
NORTHING: 217888.7726
EASTING: 632458.9606
TOTAL BORING DEPTH (ft bgs): 60.00
DEPTH TO WATER (ft bgs): 4.00
TOTAL DEPTH ELEVATION (ft msl): -59.38

DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
-21.88	22.5	24	80	8	9	11	20		DRY	0	none	firm	2.5YR 4/6	ML CLAYEY SANDY SILT, dark red, interbedded sandy silt, sand, and clay to clayey silt
														DS=Low to Medium; D=Slow; T=Medium; P=Low
-23.38	24	25.5	100	6	11	19	30		DRY	0	none	firm	5B 7/1	ML CLAYEY SANDY SILT, mostly gray silty clay with zones of silt and f.g. sand, stiff
														DS=Low to Medium; D=Slow; T=Medium; P=Low
-24.88	25.5	27	100	9	13	21	34		DRY	0	none	firm	2.5YR 4/8	ML SILT, dark red with olive yellow mottling
														DS=Low; D=Slow; T=Low; P=Low
-26.38	27	28.5	100	10	11	15	26		DRY	0	none	v.firm	2.5YR 4/8	ML SILT, dark red, as above
		28												DS=Low; D=Slow; T=Low; P=Low
									MST				5B 7/1	CH CLAY, light grayish blue
-27.88	28.5	30	100	11	14	24	38		DMP	0	none	v.firm	2.5YR 4/8 2.5Y 6/6	ML SANDY CLAYEY SILT, mottled dark red and olive yellow, interbedded clays, silts and sands
														DS=Low to Medium; D=Slow; T=Medium; P=Low
-29.38	30	31.5	80	6	10	15	25		DRY	0	none	firm	5YR 4/6	ML SANDY SILT, yellowish red, f.g. sand
														DS=Low; D=Slow; T=Low; P=Low to Non
-30.88	31.5	33	100	7	19	34	53		DRY	0	none	firm	5YR 4/6	ML SANDY SILT, yellowish red, as above
														DS=Low; D=Slow; T=Low; P=Low to Non
-32.38	33	34.5	100	12	15	22	37		MST	0	none	firm	10YR 5/6	ML SANDY SILT, yellowish brown
														DS=Low; D=Slow; T=Low; P=Low to Non

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart

DS: Dry Strength

BORING LOG

SITE ID CB-MPUC-L2

 DATE: 12 Feb 97

Begin Boring: 12-Feb-97
End Boring: 13-Feb-97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: E. Hood
DRILLING CO: SUELOS, INC
RIG TYPE: Trailer-mounted Acker 82

ELEV (GRND): 0.6200
NORTHING: 217888.7726
EASTING: 632458.9606
TOTAL BORING DEPTH (ft bgs): 60.00
DEPTH TO WATER (ft bgs): 4.00
TOTAL DEPTH ELEVATION (ft msl): -59.38

DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
-33.88	34.5	36	100	15	25	35	60		MST	0	none	v.firm	10YR 5/6	ML SANDY CLAYEY SILT, yellowish brown DS=Low to Medium; D=Slow; T=Medium; P=Low to Medium
-35.38	36	37.5	100	8	16	23	39		MST	0	none	v.firm	10YR 5/6	ML SANDY CLAYEY SILT, as above DS=Low to Medium; D=Slow; T=Medium; P=Low to Medium
-36.88	37.5	39	100	9	18	26	44		MST	0	none	v.firm	10YR 5/6	ML SANDY CLAYEY SILT, as above DS=Low to Medium; D=Slow; T=Medium; P=Low to Medium
-38.38	39	40.5	100	9	15	27	42		MST	0	none	v.firm	10YR 5/6	ML SANDY CLAYEY SILT, as above DS=Low to Medium; D=Slow; T=Medium; P=Low to Medium
-39.88	40.5	42	100	16	21	28	49		MST	0	none	v.firm	10YR 5/6	ML SANDY CLAYEY SILT, as above DS=Low to Medium; D=Slow; T=Medium; P=Low to Medium
-41.38	42	43.5	50	8	15	22	37		MST	0	none	v.firm	10YR 5/6	ML CLAYEY SANDY SILT, yellowish brown DS=Low; D=Slow; T=Medium; P=Low to Medium
-42.88	43.5	45	100	6	8	13	21		MST	0	none	v.firm	10YR 5/6	ML CLAYEY SANDY SILT, yellowish brown, mottled DS=Low; D=Slow; T=Medium; P=Low to Medium
-44.38	45	46.5	100	8	11	19	30		MST	0	none	v.firm	10YR 5/6	ML SANDY CLAYEY SILT, yellowish brown DS=Low to Medium; D=Slow; T=Medium; P=Low to Medium

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart

DS: Dry Strength

BORING LOG

SITE ID CB-MPUC-L2

 DATE: 12 Feb 97

CLIENT:	U.S. Army Corps of Engineers	ELEV (GRND):	0.6200
SITE NAME:	Martin Pena Canal	NORTHING:	217888.7726
PROJECT NO.:	03886-136-005	EASTING:	632458.9606
CONTRACT NO:	DACW17-95-D-0017 (DO-5)	TOTAL BORING DEPTH (ft bgs):	60.00
LOGGED BY:	E. Hood	DEPTH TO WATER (ft bgs)	4.00
DRILLING CO:	SUELOS, INC	TOTAL DEPTH ELEVATION (ft msl)	-59.38
RIG TYPE:	Trailer-mounted Acker 82		

Begin Boring: 12-Feb-97
End Boring: 13-Feb-97
DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
-45.88	46.5	48	66	6	12	15	27		MST	0	none	v.firm	10YR 5/6	ML CLAYEY SILT, yellowish brown DS=Medium; D=Slow; T=Medium; P=Medium
-47.38	48	49.5	100	9	15	19	34		MST	0	none	firm	10YR 6/8	SC/SM CLAYEY SILTY SAND, brownish yellow
-48.88	49.5	51	100	12	16	23	39		MST	0	none	v.firm	10YR 6/8	SC/SM SILTY CLAYEY SAND, yellowish brown, sand m.g. quartz, rounded to subrounded
-50.38	51	52.5	100	6	10	13	23		MST	0	none	firm	10YR 6/8	SC/SM SILTY CLAYEY SAND, yellowish brown, sand f.g. quartz, rounded to subrounded
-51.88	52.5	54	100	12	12	12	24		MST	0	none	firm	10YR 7/1	SC CLAYEY SAND, light gray
-53.38	54	55.5	66	7	6	11	17		MST	0	none	firm	2.5YR 4/4	SC/SM SILTY CLAYEY SAND, olive brown, sand quartz and carbonate? m.g. rounded to subrounded
-54.88	55.5	57	100	6	8	15	23		MST	0	none	firm	2.5Y 4/4	SC/SM SILTY CLAYEY SAND, as above
-56.38	57	58.5	100	7	8	14	22		MST	0	none	firm	2.5Y 4/4	SC/SM SANDY SILTY CLAY, light olive brown, sand f.g. to m.g.
-57.88	58.5	60	100	11	13	19	32		MST	0	none	firm	2.5Y 5/4	SC/SM SANDY CLAYEY SILT, light olive brown BORING TERMINATED

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart

DS: Dry Strength

BORING LOG

SITE ID: CB-MPUC-L3

 DATE: 10Feb 97

Begin Boring: 10-Feb-97
End Boring: 11-Feb-97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: E. Hood
DRILLING CO: SUELOS, INC
RIG TYPE: Trailer-mounted Acker 82

ELEV (GRND): 2.3590
NORTHING: 217350.0000
EASTING: 633669.0000
TOTAL BORING DEPTH (ft bgs): 60.00
DEPTH TO WATER (ft bgs): 2.00
TOTAL DEPTH ELEVATION (ft msl): -57.64

DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
2.359	0	1.5	33	9	6	6	12	fill	DRY	1	none	soft	10YR 5/6	ML SILT, yellowish brown mottled with brown, covered with 2 inches of asphalt FILL
0.859	1.5	3	34	6	3	8	11		SAT	0	none	soft	2.5Y 5/4	ML GRAVELY SANDY SILT, very loose, gravel consists of construction debris, (FILL) light olive brown
-0.641	3	4.5	44	2	1	2	3		WET	0	waste	soft	2.5Y 4/1	ML SANDY CLAYEY SILT, dark gray, texture suggests fill material FILL
-2.141	4.5	6	100	3	4	5	9		SAT	0	waste	soft	5Y 4/2	AS ABOVE 20% Lower Explosive Limit (LEL) in augers
-3.641	6	7.5	34	4	3	4	7		SAT	0	none	soft	5Y 5/2	CL/ML SANDY SILTY CLAY, olive gray FILL
-5.141	7.5	9	100	1	1	1	2	soil	WET	1	sulfur	v.soft	2.5Y 2.5/1	OL/OH SILTY CLAY, black very soft, organic DS=Low to Medium; D=Slow; T=Low; P=Low
-6.641	9	10.5	100	1	1	1	2		MST	125	sulfur	v.soft	10YR 2/1	OL/OH SILT, black, organic-rich DS=Low to Medium; D=Slow; T=Low; P=Low

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm
[b] Color based on the Munsel Soil Color Chart

DS: Dry Strength
D: Dilatancy
T: Toughness
P: Plasticity

BORING LOG

SITE ID CB-MPUC-L3

 DATE: 10Feb 97

CLIENT:	U.S. Army Corps of Engineers
SITE NAME:	Martin Pena Canal
PROJECT NO.:	03886-136-005
CONTRACT NO:	DACW17-95-D-0017 (DO-5)
LOGGED BY:	E. Hood
DRILLING CO:	SUELOS, INC
RIG TYPE:	Trailer-mounted Acker 82

ELEV (GRND):	2.3590
NORTHING:	217350.0000
EASTING:	633669.0000
TOTAL BORING DEPTH (ft bgs):	60.00
DEPTH TO WATER (ft bgs)	2.00
TOTAL DEPTH ELEVATION (ft msl)	-57.64

Begin Boring: 10-Feb-97
End Boring: 11-Feb-97

DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENC	COLOR[b]	LITHOLOGIC DESCRIPTION
-8.141	**10.5**	**12**	100	1	1	1	**2**		MST	2	sulfur	v.soft	10YR 2/1	**OL/OH** ORGANIC SILT, black, organic-rich (Original natural organic sediment prior to filling) DS=Low to Medium; D=Slow; T=Low; P=Low
-9.641	**12**	**13.5**	100	1	1	1	**2**		SAT	44	sulfur	v.soft	10YR 2/1	**OL/OH** ORGANIC SILT, black DS=Low to Medium; D=Slow; T=Low; P=Low
-11.141	**13.5**	**15**	100	1	2	4	**6**		WET	0	sulfur	soft	5Y 4/3	**CL/ML** SILTY CLAY, olive with some organics DS=Medium; D=Slow; T=Medium; P=Medium
-12.641	**15**	**16.5**	100	2	2	3	**5**		WET	0	none	soft	5Y 4/3	**CL/ML** SILTY CLAY, olive DS=Medium; D=Slow; T=Medium; P=Medium
-14.141	**16.5**	**18**	44	1	3	4	**7**		MST	0	none	firm	2.5Y4/4	**ML** SILT, olive brown with interbeds of clayey silt DS=Low; D=Slow to Rapid; T=Low; P=Low
-15.641	**18**	**19.5**	80	3	5	11	**16**		MST	0	none	firm	2.5Y 5/1	**CL/ML** SILTY CLAY, gray with interbeds of clayey silt DS=Medium; D=Slow; T=Medium; P=Medium
-17.141	**19.5**	**21**	66	2	8	13	**21**		DRY	0	none	v.firm	7.5YR 4/4	**ML** SILT, strong brown mottled with red and yellow DS=Low; D=Slow to Rapid; T=Low; P=Low
-18.641	**21**	**22.5**	50	11	15	18	**33**		MST	0	none	v.firm	5BG 7/1	**CL/ML** SILTY CLAY, light blueish gray to brown DS=Medium; D=Slow; T=Medium; P=Medium

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart

DS: Dry Strength
D: Dilatancy

BORING LOG

SITE ID CB-MPUC-L3

 DATE: 10Feb 97

Begin Boring: 10-Feb-97
End Boring: 11-Feb-97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: E. Hood
DRILLING CO: SUELOS, INC
RIG TYPE: Trailer-mounted Acker 82

ELEV (GRND): 2.3590
NORTHING: 217350.0000
EASTING: 633669.0000
TOTAL BORING DEPTH (ft bgs): 60.00
DEPTH TO WATER (ft bgs): 2.00
TOTAL DEPTH ELEVATION (ft msl): -57.64

DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
-20.141	22.5	24	100	9	17	21	38		DRY	0	none	firm	10YR 5/8	ML SILT, yellowish brown with interbeds of clayey silt mottled with red and brown DS=Low; D=Slow to Rapid; T=Low; P=Low
-21.641	24	25.5	100	8	15	20	35		DRY	0	none	v.firm	7.5YR 4/6	ML SANDY SILT, strong brown, sand f.g. DS=Low; D=Slow to Rapid; T=Low; P=Low
-23.141	25.5	27	87	13	17	27	44		DRY	0	none	firm	10YR 5/8	ML SILT, yellowish brown with interbeds of gray silty clay DS=Low; D=Slow to Rapid; T=Low; P=Low
-24.641	27	28.5	83	8	12	28	40		DRY	0	none	v.firm	10YR 5/6	ML SILT, yellowish brown with interbeds of gray clay DS=Low; D=Slow to Rapid; T=Low; P=Low
-26.141	28.5	30	50	8	14	19	33		MST	0	none	v.firm	5BG 7/1	CH CLAY, light blueish gray with interbeds of strong brown silty clay DS=Medium; D=Slow to None; T=Medium; P=Medium
-27.641	30	31.5	100	4	7	14	21		MST	1	none	v.firm	7.5YR 4/6	ML SANDY SILT, strong brown with f.g. sand DS=Low; D=Slow to Rapid; T=Low; P=Low
-29.141	31.5	33	80	11	16	19	35		MST	0	none	v.firm	10YR 5/6	ML CLAYEY SILT, yellowish brown DS=Medium; D=Slow; T=Medium; P=Medium to Low
-30.641	33	34.5	100	11	21	26	47		MST	0	none	firm	10YR 5/6	ML CLAYEY SILT, yellowish brown with interbeds of gray clay

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart

DS: Dry Strength
D: Dilatancy

BORING LOG

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: E. Hood
DRILLING CO: SUELOS, INC
RIG TYPE: Trailer-mounted Acker 82

ELEV (GRND): 2.3590
NORTHING: 217350.0000
EASTING: 633669.0000
TOTAL BORING DEPTH (ft bgs): 60.00
DEPTH TO WATER (ft bgs): 2.00
TOTAL DEPTH ELEVATION (ft msl): -57.64

SITE ID: CB-MPUC-L3

DATE: 10Feb 97
Begin Boring: 10-Feb-97
End Boring: 11-Feb-97
DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENC	COLOR[b]	LITHOLOGIC DESCRIPTION
-32.141	34.5	36	100	10	15	18	33		DMP	0	none	firm	10YR 5/6	**ML** CLAYEY SILT, yellowish brown as above DS=Medium; D=Slow; T=Medium; P=Medium to Low
-33.641	36	37.5	100	13	18	21	39		DMP	0	none	firm	10YR 5/6	**ML** CLAYEY SILT, as above DS=Medium; D=Slow; T=Medium; P=Medium to Low
-35.141	37.5	39	100	6	12	17	29		DMP	0	none	firm	10YR 5/8	**ML** SANDY SILT, yellowish brown with interbeds of red and black organic silt DS=Medium to Low; D=Slow; T=Medium; P=Low
-36.641	39	40.5	100	7	12	15	37		DMP	0	none	firm	10YR 5/8	**ML** SANDY SILT, yellowish brown with black and red interbeds DS=Medium to Low; D=Slow; T=Medium; P=Low
-38.141	40.5	42	100	10	13	15	28		DMP	0	none	firm	10YR 5/8	**ML** SANDY SILT, as above DS=Medium to Low; D=Slow; T=Medium; P=Low
-39.641	42	43.5	100	6	8	12	20		MST	0	none	firm	10YR 5/8	**ML/CL** CLAYEY SANDY SILT, yellowish brown DS=Medium to Low; D=Slow; T=Medium; P=Low to Medium
-41.141	43.5	45	100	6	9	14	23		MST	0	none	firm	10YR 5/8	**ML/CL** CLAYEY SILT, yellowish brown DS=Medium; D=Slow; T=Medium; P=Medium to Low
-42.641	45	46.5	40	6	24	40	64	brk	DMP	0	none	v.firm	2.5Y 8/6	**CL** GRAVELY SANDY CLAY, yellow with carbonate gravel

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart
brk: bedrock

DS: Dry Strength
D: Dilatancy
T: T...

BORING LOG

SITE ID: CB-MPUC-L3

DATE: 10Feb 97

Begin Boring: 10-Feb-97
End Boring: 11-Feb-97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: E. Hood
DRILLING CO: SUELOS, INC
RIG TYPE: Trailer-mounted Acker 82

ELEV (GRND): 2.3590
NORTHING: 217350.0000
EASTING: 633669.0000
TOTAL BORING DEPTH (ft bgs): 60.00
DEPTH TO WATER (ft bgs): 2.00
TOTAL DEPTH ELEVATION (ft msl): -57.64

DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
-44.141	46.5	48	100	23	17	19	36		SAT	0	none		2.5Y7/4	SW SAND, f.g. to m.g. quartz sand clay layer at 47.9
-45.641	48	49.5	100	6	8	27	35		WET	0	none		10YR 6/6	SW SAND, brownish yellow, f.g. to m.g quartz sand 49.3-49.5 clay and carbonate rock, yellow
-47.141	49.5	51	66	45	48	16	64		WET	0	none		2.5Y 7/6	GP SANDY GRAVEL, yellow angular fragments
-48.641	51	52.5	80	40	23	50	73		WET	0	none		2.5Y 7/6	GP SANDY GRAVEL, as above
-50.141	52.5	54	100	7	11	14	25		DMP	0	none	soft	10YR 5/6	ML SANDY SILT, yellowish brown, finely interbedded red to gray to brown. DS=Low; D=Rapid; T=Low; P=Low to Non
-51.641	54	55.5	100	11	18	24	42		MST	0	none	firm	10YR 5/6	CL/ML SILTY CLAY 55.2-55.5, carbonate rock and clay DS=Medium; D=Slow; T=Medium to Low; P=Medium
-53.141	55.5	57	67	31	20	20	40		WET	0	none		2.5Y 7/6	GP SANDY GRAVEL, angular carbonate gravel in a yellow clayey sand matrix
-54.641	57	58.5	100	40	41	25	66		SAT	0	none		2.5Y 7/6	AS ABOVE
-56.141	58.5	60	44	10	12	20	32		WET	0	none		2.5Y 7/6	AS ABOVE, BORING TERMINATED

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart

DS: Dry Strength
D: Dilatancy

BORING LOG

SITE ID CB-MPUC-L4

 DATE: 17Feb97

Begin Boring: 13-Feb-97
End Boring: 17-Feb-97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: E. Hood
DRILLING CO: SUELOS, INC
RIG TYPE: Trailer-mounted Acker 82

ELEV (GRND): 1.3140
NORTHING: 216581.1707
EASTING: 635656.3228
TOTAL BORING DEPTH (ft bgs): 60.00
DEPTH TO WATER (ft bgs): 4.00
TOTAL DEPTH ELEVATION (ft msl): -58.69

DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE 0	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
1.314	0	- 1.5	57	8	10	9	19	brk	DRY	0	none		10YR 5/6	GP/GC SANDY CLAYEY GRAVEL, yellowish brown, gravel angular limestone
-0.186	1.5	3	100	13	19	19	38		DMP	0	none		2.5Y 4/4	GP SANDY GRAVEL, light yellowish brown, as above
-1.686	3	4.5	100	11	11	14	25		WET	0	none		2.5Y 6/4	SM SILTY SAND, light yellowish brown with limestone gravel
-3.186	4.5	6	100	7	8	10	18		SAT	0	none		2.5Y 6/4	SM SILTY SAND, as above
-4.686	6	7.5	66	15	25	15	40		WET	0	none		2.5Y 6/6	SM SILTY SAND, olive yellow
-6.186	7.5	9	100	15	9	6	15		WET	0	none		2.5Y6/4	SM SILTY SAND, as above
-7.686	9	10.5	100	6	7	10	17		WET	0	none		2.5Y 6/4	SM SILTY SAND, light yellowish brown, interbedded sandy silt, sand and clayey zones

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart
brk: bedrock

DS: Dry Strength
D: Dilatancy

BORING LOG

SITE ID CB-MPUC-L4

DATE: 17Feb97

Begin Boring: 13-Feb-97
End Boring: 17-Feb-97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: E. Hood
DRILLING CO: SUELOS, INC
RIG TYPE: Trailer-mounted Acker 82

ELEV (GRND): 1.3140
NORTHING: 216581.1707
EASTING: 635656.3228
TOTAL BORING DEPTH (ft bgs): 60.00
DEPTH TO WATER (ft bgs): 4.00
TOTAL DEPTH ELEVATION (ft msl): -58.69

DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
-9.186	10.5	12	57	8	9	11	20		MST	0	none	firm	2.5Y 4/3	CL/ML CLAYEY SANDY SILT, olive brown DS=Low; D=Slow to Rapid; T=Low; P=Low
-10.686	12	13.5	66	6	12	15	27		WET	0	none		2.5Y 5/3	SM SILTY SAND, olive brown, sand f.g.
-12.186	13.5	15	44	11	12	13	25		WET	0	none	soft	2.5Y 5/3	SC/SM CLAYEY SILTY SAND TO SANDY SILT, light olive brown with some angular carbonate fragments
-13.686	15	16.5	57	12	12	16	28		WET	0	none		2.5Y 6/4	SM SILTY SAND, light yellowish brown
-15.186	16.5	18	44	15	29	17	46		WET	0	none		2.5Y 6/4	GP SANDY GRAVEL, light yellowish brown, angular limestone fragments in a f.g. to c.g. sand to silty sand matrix
-16.686	18	19.5	57	8	8	15	23		WET	0	none	soft	2.5Y 6/4	CL GRAVELY CLAY, light olive brown DS=Medium; D=Slow; T=Medium; P=Medium
-18.186	19.5	21	66	4	2	4	6		MST	0	none	soft	2.5Y 5/4	ML CLAYEY SANDY SILT, light olive brown DS=Low; D=Slow to Rapid; T=Low; P=Low
-19.686	21	22.5	57	2	2	4	6		MST	0	none	soft	2.5Y 5/4	ML CLAYEY SANDY SILT, as above DS=Low; D=Slow to Rapid; T=Low; P=Low

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart

DS: Dry Strength

BORING LOG

SITE ID CB-MPUC-L4

 DATE: 17Feb97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: E. Hood
DRILLING CO: SUELOS, INC
RIG TYPE: Trailer-mounted Acker 82

ELEV (GRND): 1.3140
NORTHING: 216581.1707
EASTING: 635656.3228
TOTAL BORING DEPTH (ft bgs): 60.00
DEPTH TO WATER (ft bgs): 4.00
TOTAL DEPTH ELEVATION (ft msl): -58.69

Begin Boring: 13-Feb-97
End Boring: 17-Feb-97
DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
-21.186	22.5	24	66	5	7	25	32		WET	0	none	firm	2.5Y 5/4	ML CLAYEY SANDY SILT, as above DS=Low; D=Slow to Rapid; T=Medium; P=Low
-22.686	24	25.5	100	11	14	17	31		MST	0	none		5B 6/1	SC/SM SAND, blueish gray, m.g. quartz sand with clayey sand interbeds
-24.186	25.5	27	56	19	75/4				MST	0	none	v.firm	2.5Y 4/4	CL/ML SILTY SANDY CLAY, olive brown DS=Medium to Low; D=Non; T=Medium; P=Medium to Low
-25.686	27	28.5	57	15	10	19	29		MST	0	none	soft	2.5Y 4/4	SC/SM CLAYEY SILTY SAND, olive brown
-27.186	28.5	30	57	12	20	17	37		MST	0	none	v.firm	2.5Y 4/4	CL/ML GRAVELY SANDY CLAY, olive brown, gravel angular carbonate fragments DS=Low to Medium; D=SLow; T=Medium; P=Medium
-28.686	30	31.5	66	10	10	17	27		MST	0	none	v.firm	2.5Y 4/4	CL/ML GRAVELY SANDY CLAY, as above DS=Low to Medium; D=SLow; T=Medium; P=Medium
-30.186	31.5	33	44	2	8	11	19		MST	0	none	v.firm	2.5Y 4/4	CL/ML SILTY SANDY CLAY, olive brown DS=Low to Medium; D=SLow; T=Medium; P=Medium
-31.686	33	34.5	67	12	14	18	32		WET	0	none		2.5Y 5/4	SM SILTY SAND, light yellowish brown, some angular carbonate fragments

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart

DS: Dry Strength

BORING LOG

SITE ID CB-MPUC-L4

 DATE: 17Feb 97

Begin Boring: 13-Feb-97
End Boring: 17-Feb-97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: E. Hood
DRILLING CO: SUELOS, INC
RIG TYPE: Trailer-mounted Acker 82

ELEV (GRND): 1.3140
NORTHING: 216581.1707
EASTING: 635656.3228
TOTAL BORING DEPTH (ft bgs): 60.00
DEPTH TO WATER (ft bgs): 4.00
TOTAL DEPTH ELEVATION (ft msl): -58.69

DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
-33.186	34.5	36	57	12	12	8	20		MST	0	none	v.firm	2.5Y 4/4	CL/ML SILTY SANDY CLAY, olive brown, gravelly (limestone)
														DS=Low; D=SLow; T=Medium; P=Medium to low
-34.686	36	37.5	44	9	9	9	18		WET	0	none		2.5Y 6/4	SM GRAVELY SILTY SAND, light yellowish brown
-36.186	37.5	39	17	2	3	5	8		WET	0	none		2.5Y 6/4	GP LIMESTONE GRAVEL, not enough to characterize
-37.686	39	40.5	77	6	7	9	16		WET	0	none	soft	2.5Y 6/4	CL/ML GRAVELY SANDY CLAY, pale olive, angular limestone fragments
														DS=Low; D=SLow; T=Medium; P=Medium to low
-39.186	40.5	42	77	11	8	14	22		WET	0	none	soft	5Y 6/4	ML GRAVELY SANDY SILT, pale olive, as above
														DS=Low; D=Slow to Rapid; T=Low; P=Low to Non
-40.686	42	43.5	57	7	7	14	21		WET	0	none	soft	5Y 6/4	ML SANDY SILT, as above
														DS=Low; D=Slow to Rapid; T=Low; P=Low to Non
-42.186	43.5	45	57	19	6	6	12		WET	0	none	firm	5Y 6/4	ML SANDY SILT, as above
														DS=Low; D=Slow to Rapid; T=Low; P=Low to Non
-43.686	45	46.5	57	6	4	3	7		SAT	0	none	soft	2.5Y 5/4	ML SANDY SILT, light olive brown, loose
														DS=Low; D=Slow to Rapid; T=Low; P=Low to Non

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart

DS: Dry Strength

BORING LOG

SITE ID CB-MPUC-L4

 DATE: 17Feb97

Begin Boring: 13-Feb-97
End Boring: 17-Feb-97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: E. Hood
DRILLING CO: SUELOS, INC
RIG TYPE: Trailer-mounted Acker 82

ELEV (GRND): 1.3140
NORTHING: 216581.1707
EASTING: 635656.3228
TOTAL BORING DEPTH (ft bgs): 60.00
DEPTH TO WATER (ft bgs): 4.00
TOTAL DEPTH ELEVATION (ft msl): -58.69

DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
-45.186	46.5	48	77	2	5	13	18		SAT	0	none	soft	2.5Y 5/4	ML SANDY SILT, light olive brown DS=Low; D=Rapid; T=Low; P=Non
-46.686	48	49.5	77	13	8	19	27		MST	0	none		2.5Y 5/3	SM SILTY SAND, light olive brown, sand m.g. quartz, some carbonate sand
-48.186	49.5	51	44	13	20	12	32		MST	0	none		2.5Y 5/3	SM GRAVELY SILTY SAND, interbedded limestone gravel and silty sand
-49.686	51	52.5	0	4	8	12	20		NA	NA	NA	NA	NA	NO RECOVERY
-51.186	52.5	54	78	5	8	7	15		WET	0	none		5Y 5/3 2.5Y 5/3	SM GRAVELY SILTY SAND, olive to olive brown, gravel angular limestone fragments, texture suggestive of karst breccia
-52.686	54	55.5	39	30	22	24	46		WET	0	none		2.5Y 5/3	SM GRAVELY SILTY SAND as above
-54.186	55.5	57	33	15	15	65	80		WET	0	none		2.5Y6/3 10YR 7/4	GM SILTY SANDY GRAVEL, olive brown with pale brown limestone clasts. (brecciated limestone)
-55.686	57	58.5	44	9	5	15	20		DMP	0	none		2.5Y 5/3	SM GRAVELY SILTY SAND, olive brown, as above
-57.186	58.5	60	50	16	26	20	46		DMP	0	none		2.5Y 5/3	GM SILTY SANDY GRAVEL, as above BORING TERMINATED

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart

DS: Dry Strength
D: Dilatancy

BORING LOG

SITE ID CB-MPUC-L5

 DATE: 17Feb97

Begin Boring: 18-Feb-97
End Boring: 18-Feb-97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: T. FRINAK
DRILLING CO: SUELOS, INC
RIG TYPE: Trailer-mounted CME 45

ELEV (GRND): 2.8530
NORTHING: 217319.7200
EASTING: 636641.9392
TOTAL BORING DEPTH (ft bgs): 60.00
DEPTH TO WATER (ft bgs): 4.50
TOTAL DEPTH ELEVATION (ft msl): -57.15

DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-Value 0	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
2.853	0	1.5	67	4	6	5	11	brk	DMP	0	none		10YR 5/4	GC/GM CLAYEY SILTY GRAVEL, yellow brown, gravel angular limestone
1.353	1.5	3	72	7	6	5	11		DMP	0	none		10YR 5/4	GC/GM SILTY SANDY GRAVEL, as above
-0.147	3	4.5	83	4	3	3	6		DMP	0	none		10YR 7/8	SP SAND, yellow, c.g. quartz with interbeds of silty clayey sand
-1.647	4.5	6	89	1	1	2	3		SAT	0	none		10YR 6/8	SP SAND, as above
-3.147	6	7.5	67	5	3	6	9		SAT	0	none		10YR 6/8	GC/GM CLAYEY SILTY GRAVEL, brownish yellow
-4.647	7.5	9	100	3	4	5	9		WET	0	none		10YR 6/8	GC/GM CLAYEY SILTY GRAVEL, brownish yellow, sand primarily quartz with some calcite?/araganite? (from shell debris?)
-6.147	9	10.5	56	5	5	6	11		WET	0	none		10YR 6/6	GP GRAVEL, brownish yellow

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart
brk: bedrock

DS: Dry Strength
D: Dilatancy

BORING LOG

SITE ID CB-MPUC-L5

Page 2 of 5 DATE: 17Feb97

Begin Boring: 18-Feb-97
End Boring: 18-Feb-97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: T. FRINAK
DRILLING CO: SUELOS, INC
RIG TYPE: Trailer-mounted CME 45

ELEV (GRND): 2.8530
NORTHING: 217319.7200
EASTING: 636641.9392
TOTAL BORING DEPTH (ft bgs): 60.00
DEPTH TO WATER (ft bgs): 4.50
TOTAL DEPTH ELEVATION (ft msl): -57.15

DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
-7.647	10.5	12	44	5	5	5	10		WET	0	none	v.soft	10YR 6/6	ML GRAVELY SANDY SILT, interbedded with
														CL/ML GRAVELY CLAYEY SILT, firm
-9.147	12	13.5	83	6	9	9	18		WET	0	none	soft	10YR 6/6	DS=Low to Medium; D=Slow; T=Low; P=Low
														CL/ML GRAVELY CLAYEY SILT, brownish yellow
														DS=Low to Medium; D=Slow; T=Low; P=Low
-10.647	13.5	15	16	11	16	11	27		WET	0	none	soft	10YR 6/6	CL/ML GRAVELY CLAYEY SILT, as above
														DS=Low to Medium; D=Slow; T=Low; P=Low
-12.147	15	16.5	78	10	5	6	11		WET	0	none		10YR 8/6	GM SILTY GRAVEL, yellow
														gravel angular limestone in a silty matrix
-13.647	16.5	18	44	1	1	6	7		SAT	0	none		10YR 8/6	GM SILTY GRAVEL, matrix mucky
-15.147	18	19.5	100	3	7	5	12		MST	0	none	firm	10YR 5/6	CL/ML GRAVELY CLAYEY SILT, yellowish brown
														DS=Low to Medium; D=Slow; T=Low; P=Low
-16.647	19.5	21	50	12	6	7	13		WET	0	none	soft	10YR 5/6	ML GRAVELY SANDY SILT, yellowish brown, sand
														(quartz), gravel (angular limestone)
														matrix consists of silty sand
-18.147	21	22.5	89	6	7	30	37		MST	0	none		10YR 5/6	GM SANDY SILTY GRAVEL, yellowish brown

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart

DS: Dry Strength

BORING LOG

SITE ID: CB-MPUC-L5

 DATE: 17Feb97

CLIENT:	U.S. Army Corps of Engineers	ELEV (GRND):	2.8530
SITE NAME:	Martin Pena Canal	NORTHING:	217319.7200
PROJECT NO.:	03886-136-005	EASTING:	636641.9392
CONTRACT NO:	DACW17-95-D-0017 (DO-5)	TOTAL BORING DEPTH (ft bgs):	60.00
LOGGED BY:	T. FRINAK	DEPTH TO WATER (ft bgs)	4.50
DRILLING CO:	SUELOS, INC	TOTAL DEPTH ELEVATION (ft msl)	-57.15
RIG TYPE:	Trailer-mounted CME 45		

Begin Boring: 18-Feb-97
End Boring: 18-Feb-97
DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
-19.647	22.5	24	100	25	23	10	33		DMP	0	none	firm	10YR 5/6	CL/ML GRAVELY CLAYEY SILT, yellowish brown
														DS=Low; D=Slow to Rapid; T=Low; P=Low
-21.147	24	25.5	56	8	13	13	26		DMP	0	none		10YR 8/	SP SAND, white interbedded with silty sand and
													10YR 6/8	SM GRAVELY SILTY SAND, brownish yellow
-22.647	25.5	27	33	21	45	12	57		WET	0	none		10YR 5/6	GM SANDY SILTY GRAVEL, yellowish brown
-24.147	27	28.5	56	6	4	4	8		WET	0	none		10YR 5/6	GC/GM CLAYEY SILTY GRAVEL, yellowish brown
-25.647	28.5	30	33	w/h	w/h	1	1		SAT	0	none		10YR 5/6	GC/GM CLAYEY SILTY GRAVEL, yellowish brown
-27.147	30	31.5	44	w/h	7	7	14		SAT	0	none		10YR 7/8	GM SILTY GRAVEL, yellow angular limestone gravel
-28.647	31.5	33	78	15	8	6	14		DMP	0	none	firm	10YR 5/6	CL/ML GRAVELY CLAYEY SILT, yellowish brown
													10YR 7/8	interbedded with SILTY SAND
-30.147	33	34.5	78	4	5	8	13		WET	0	none		10YR 7/8	GM SANDY SILTY GRAVEL, yellow weathered
														limestone gravel

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart

DS: Dry Strength

BORING LOG

SITE ID **CB-MPUC-L5**

 DATE: 17Feb97

Begin Boring: 18-Feb-97
End Boring: 18-Feb-97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: T. FRINAK
DRILLING CO: SUELOS, INC
RIG TYPE: Trailer-mounted CME 45

ELEV (GRND): 2.8530
NORTHING: 217319.7200
EASTING: 636641.9392
TOTAL BORING DEPTH (ft bgs): 60.00
DEPTH TO WATER (ft bgs) 4.50
TOTAL DEPTH ELEVATION (ft msl) -57.15

DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
-31.647	34.5	36	78	13	40	27	67		WET	0	none		10YR 7/6	GP GRAVEL, yellow limestone gravel, angular
-33.147	36	37.5	33	12	18	34	52		SAT	0	none		10YR 7/6	GM SANDY SILTY GRAVEL, yellow, mucky
-34.647	37.5	39	66	5	7	6	13		WET	0	none	soft	10YR 7/6	CL/ML GRAVELY SILTY CLAY, yellow interbedded silt and clayey silt matrix DS=Low; D=Rapid; T=Low; P=Low
-36.147	39	40.5	78	8	12	15	27		WET	0	none	soft	10YR 7/6	CL/ML CLAYEY GRAVELY SILT, yellow DS=Low; D=Rapid; T=Low; P=Low
-37.647	40.5	42	33	6	12	9	21		WET	0	none	soft	10YR 7/6	CL/ML CLAYEY GRAVELY SILT, as above DS=Low; D=Rapid; T=Low; P=Low
-39.147	42	43.5	77	5	8	7	15		WET	0	none	soft	10YR 7/6	CL/ML GRAVELY CLAYEY SILT, interbedded with SM SILTY SAND
-40.647	43.5	45	66	11	5	5	10		WET	0	none		10YR 7/6	As above
-42.147	45	46.5	44	1	2	3	5		WET	0	none		10YR 7/8	SM SILTY SAND, yellow

[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart

DS: Dry Strength
D: Dilatancy

BORING LOG

SITE ID CB-MPUC-L5

 DATE: 17Feb97

Begin Boring: 18-Feb-97
End Boring: 18-Feb-97

CLIENT: U.S. Army Corps of Engineers
SITE NAME: Martin Pena Canal
PROJECT NO.: 03886-136-005
CONTRACT NO: DACW17-95-D-0017 (DO-5)
LOGGED BY: T. FRINAK
DRILLING CO: SUELOS, INC
RIG TYPE: Trailer-mounted CME 45

ELEV (GRND): 2.8530
NORTHING: 217319.7200
EASTING: 636641.9392
TOTAL BORING DEPTH (ft bgs): 60.00
DEPTH TO WATER (ft bgs): 4.50
TOTAL DEPTH ELEVATION (ft msl): -57.15

DRILLING TYPE: HSA
SITE TYPE: Canal ( ) Land (XX)

ELEV. (ft msl)	SAMPLE INTERVAL		RECOVERY (%)	BLOW COUNT			N-VALUE	COLUMN	MOISTURE	FIELD MONITORING PID[a]	FIELD MONITORING ODOR	CONSISTENCY	COLOR[b]	LITHOLOGIC DESCRIPTION
-43.647	46.5	48	33	4	12	15	27		WET	0	none		10YR 7/8	SM SILTY GRAVELY SAND, yellow, sand m.g. to c.g.
-45.147	48	49.5	56	17	11	20	31		WET	0	none		10YR 7/8	SM SILTY GRAVELY SAND, as above
-46.647	49.5	51	56	10	10	14	24		WET	0	none		10YR 7/8	GM SANDY SILTY GRAVEL, yellow, gravel angular limestone
-48.147	51	52.5	100	7	10	12	22		WET	0	none		10YR 7/8	As above
-49.647	52.5	54	89	8	12	20	32		WET	0	none		10YR 7/6	GC/GM CLAYEY SILTY GRAVEL, yellow, firm
-51.147	54	55.5	16	8	14	27	41		WET	0	none		10YR 7/6	GRAVEL, not enough to characterize Appears to be as above
-52.647	55.5	50	50	9	12	46	58		MST	0	none	firm	10YR 7/6	CL/ML GRAVELY CLAYEY SILT DS=Medium; D=Rapid; T=Medium; P=Low to Medium
-54.147	57	58.5	67	10	12	10	22		DMP	0	none	firm	10YR 6/8	CL/ML GRAVELY CLAYEY SILT DS=Medium; D=Rapid; T=Medium; P=Low to Medium
-55.647	58.5	60	78	11	17	11	28		DMP	0	none	firm	10YR 6/8	As above BORING TERMINATED

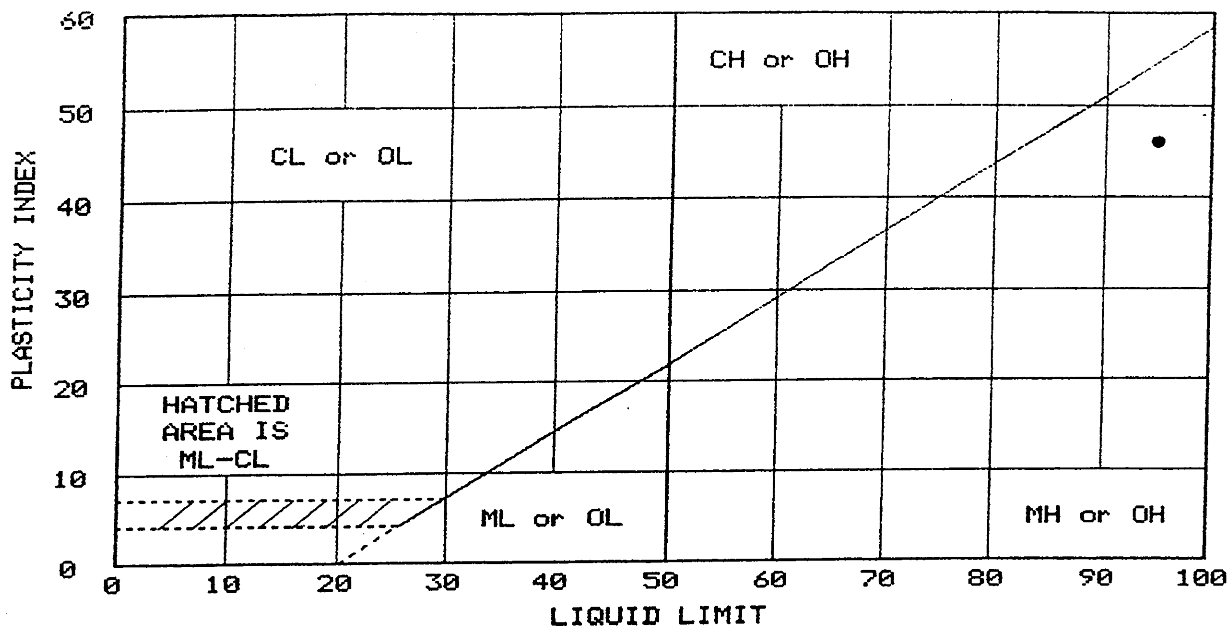
[a] Photo-ionizing Detector Monitoring Data given in relative units approximating ppm.
[b] Color based on the Munsel Soil Color Chart

DS: Dry Strength

DREDGING OF CAÑO MARTÍN PEÑA
PUERTO RICO
FINAL
PROJECT DESIGN REPORT AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX B
GEOTECHNICAL INVESTIGATIONS
TEST REPORTS
BY SUELOS, INC.

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	ORGANIC SILT,VERY DARK GRAY	95	49	46		OH	

Project No.:
Project: MARTIN PENA CHANNEL

Client: ROY F. WESTON
Location: SAN JUAN P.R.

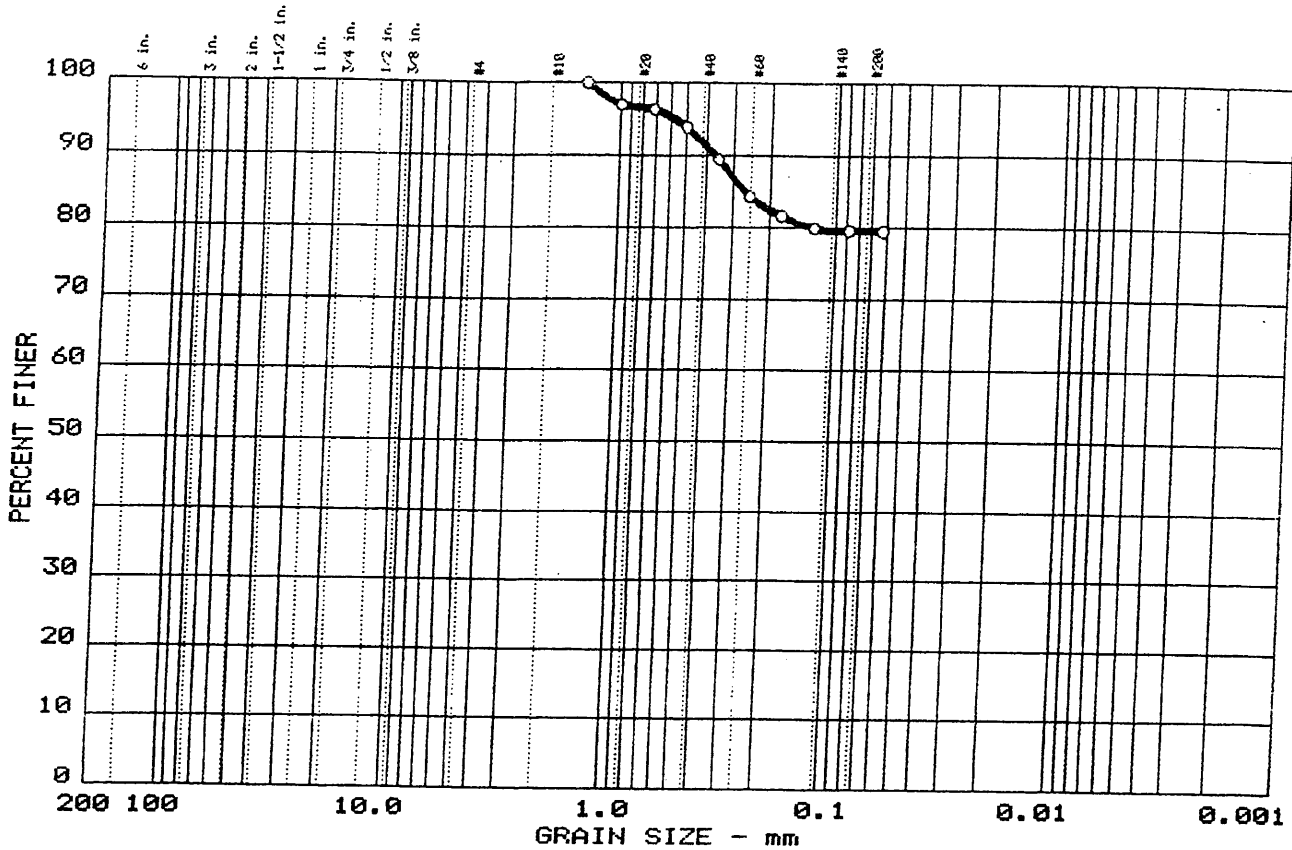
Date: 05-07-97

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MPUC-C8
SAMPLE NO. 2
DEPTH 5.5-7.0'

Fig. No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	20.5	79.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.26							

MATERIAL DESCRIPTION	USCS	AASHTO
○ SILT,ORGANIC,LITTLE SAND,VERY DARK GRAY	OH	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN PR.

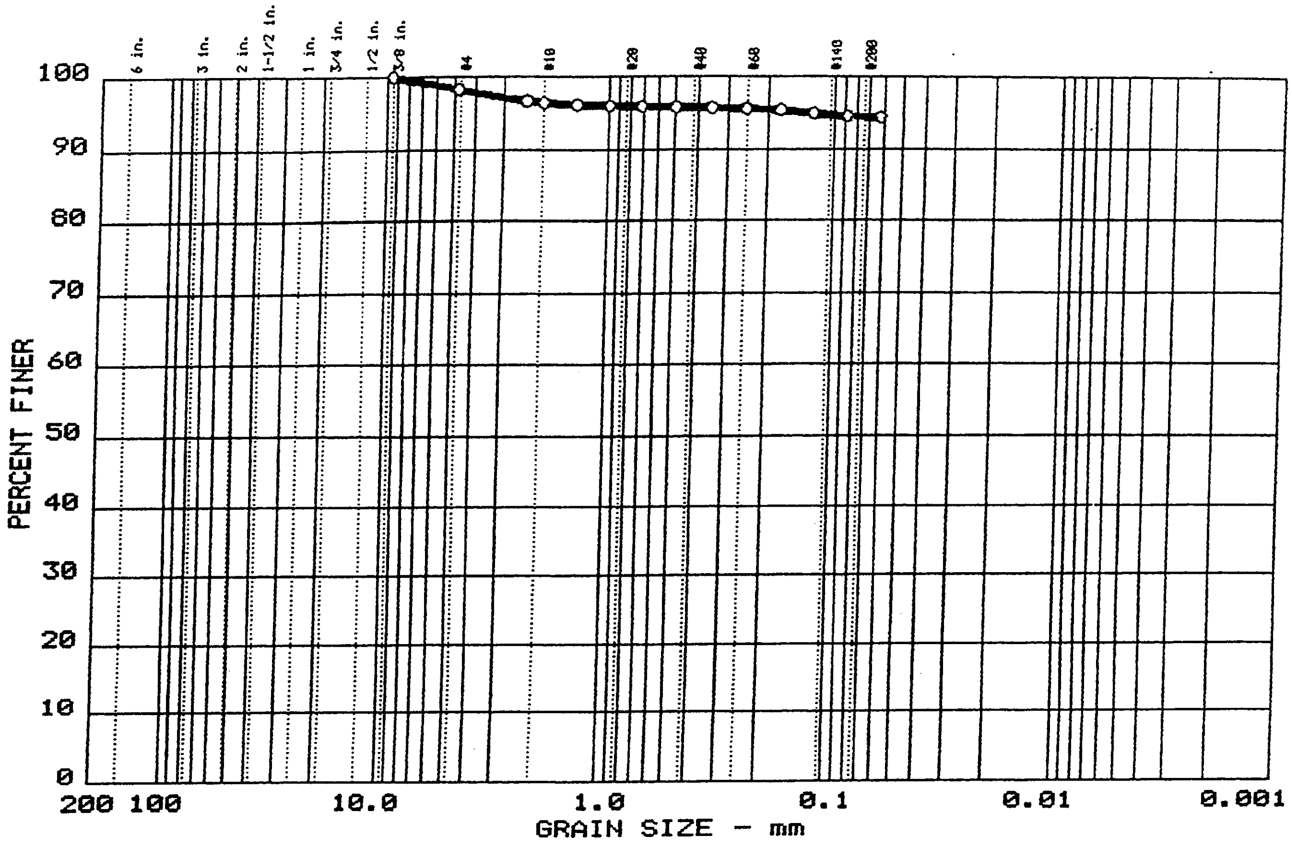
Date: 05-07-97

Remarks:
BOR.CB-MPUC-C8
SAMPLE NO. 4
DEPTH 8.5-10.0'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	1.7	3.9	94.4	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

MATERIAL DESCRIPTION	USCS	AASHTO
○ ORGANIC SILT,SOME WOOD,VERY DARK GRAY	OH	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN PR.

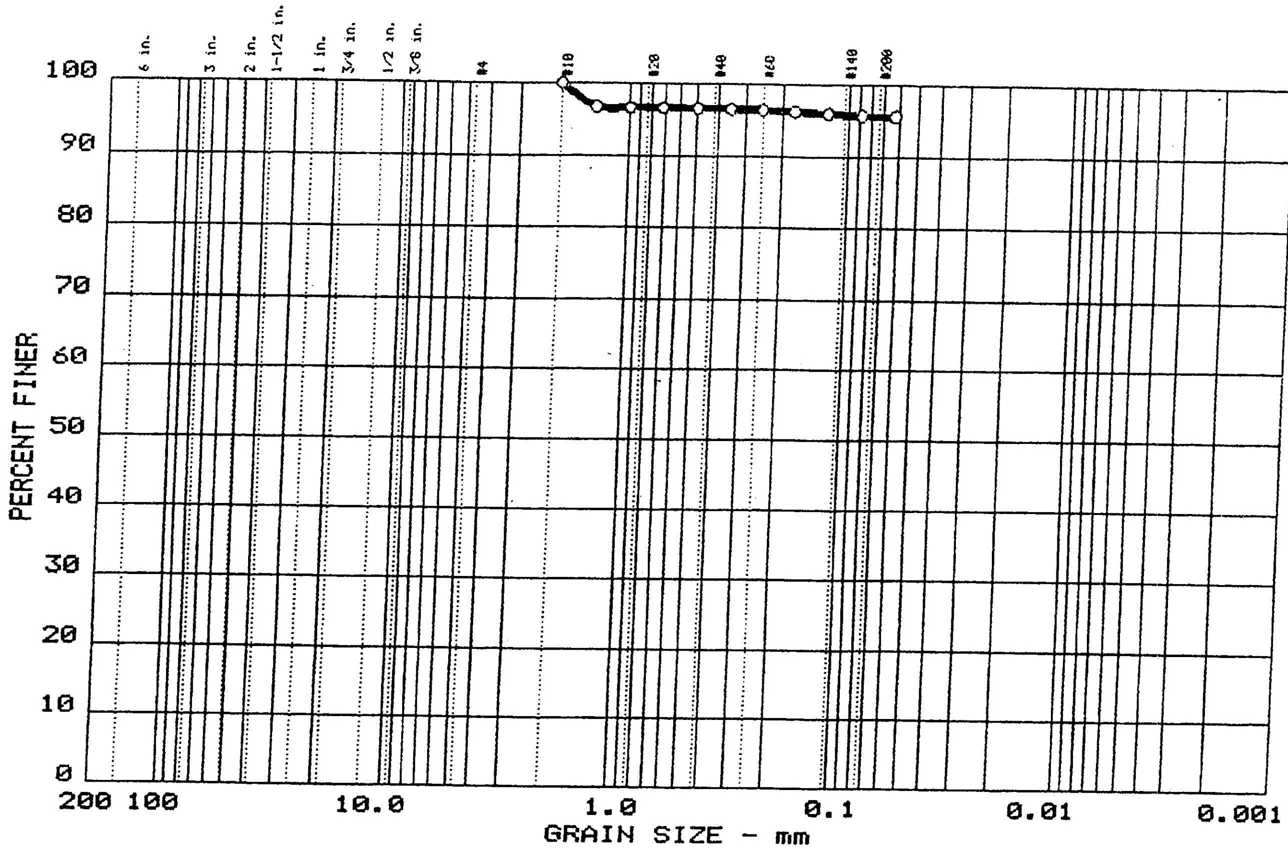
Date: 05-03-97

Remarks:
BOR.CB-MPUC-C9
SAMPLE: 1
DEPTH 4.5'TO 6.0'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No._____

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	4.4	95.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

MATERIAL DESCRIPTION	USCS	AASHTO
○ ORGANIC SILT, TRACE SAND, VERY DARK GRAY	OH	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN PR.

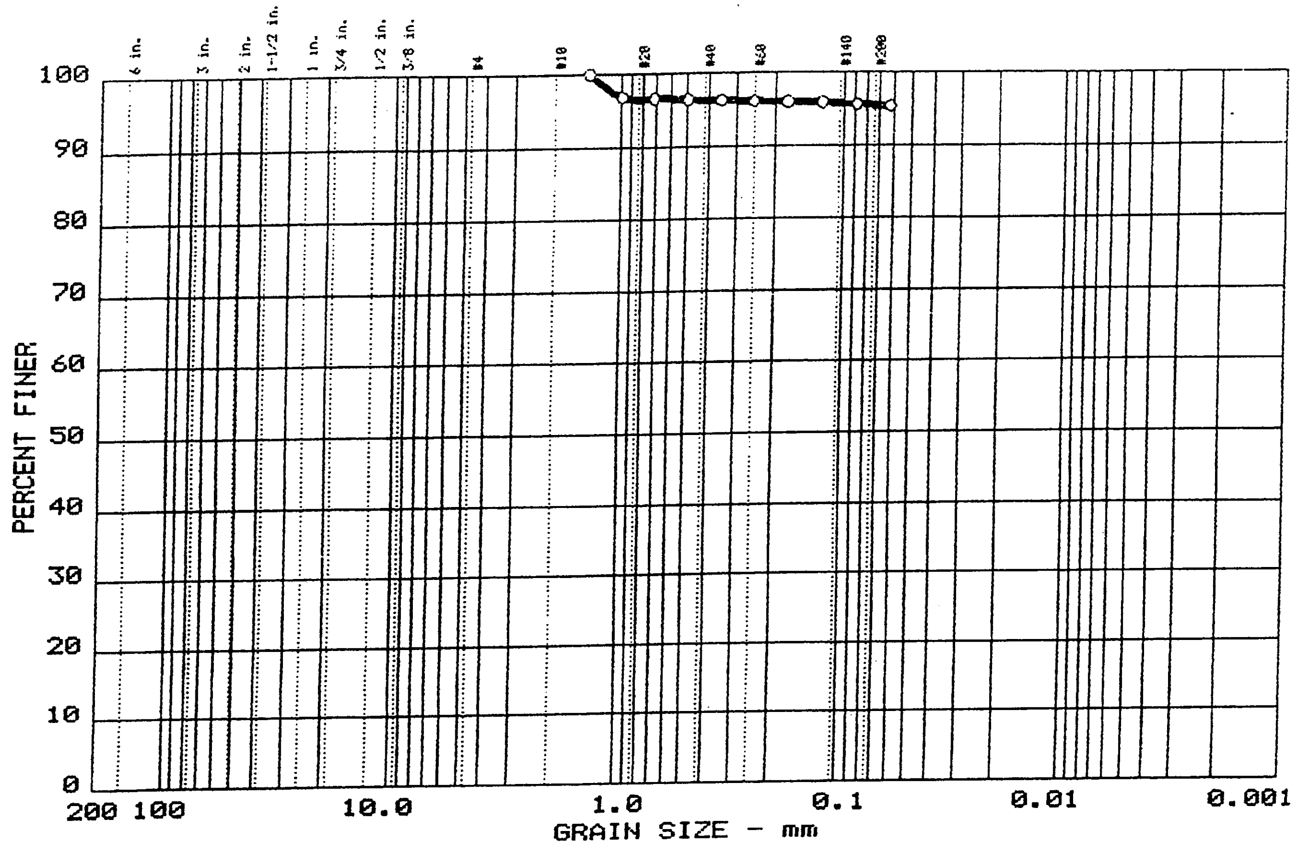
Date: 05-07-97

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MPUC-C9
SAMPLE NO. 3
DEPTH 7.5-9.0'

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	4.5	95.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

MATERIAL DESCRIPTION	USCS	AASHTO
○ ORGANIC SILT, TRACE SAND, VERY DARK GRAY	OH	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN PR.

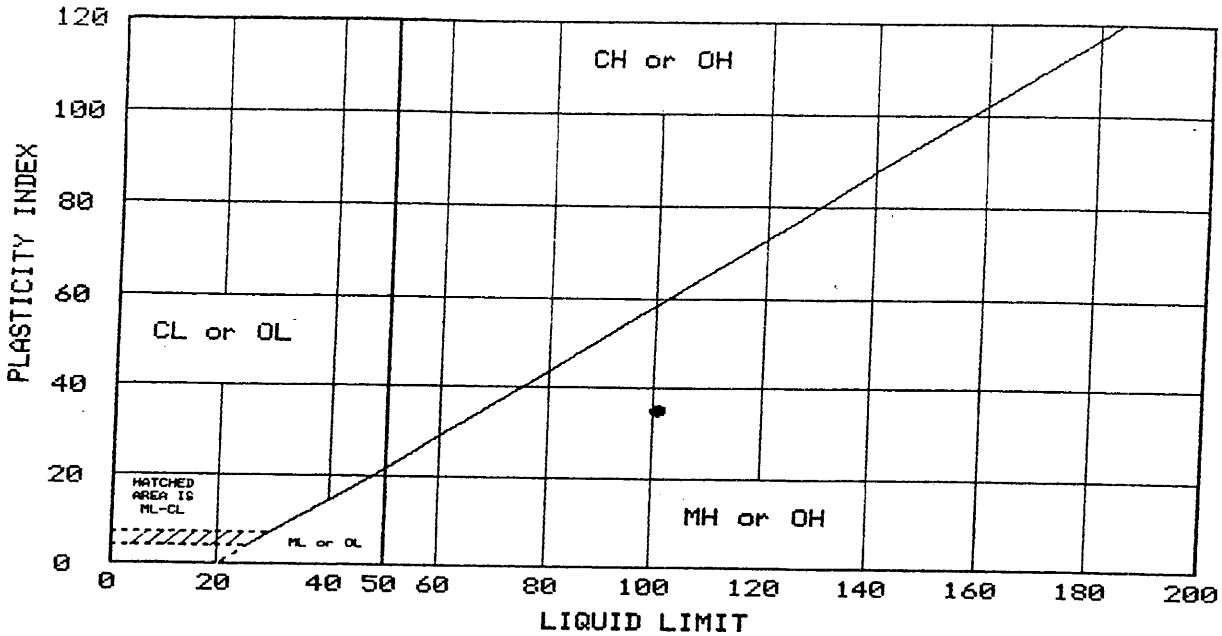
Date: 05-08-97

Remarks:
BOR. CB-MPUC-C10
SAMPLE: 2
DEPTH 4.5-6.0'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	USCS	AASHTO
● ORGANIC SILT, TRACE SAND, VERY DARK GRAY	101	66	35		OH	

Project No.:
Project: MARTIN PENA CHANNEL

Client: ROY F. WESTON
Location: SAN JUAN P.R.

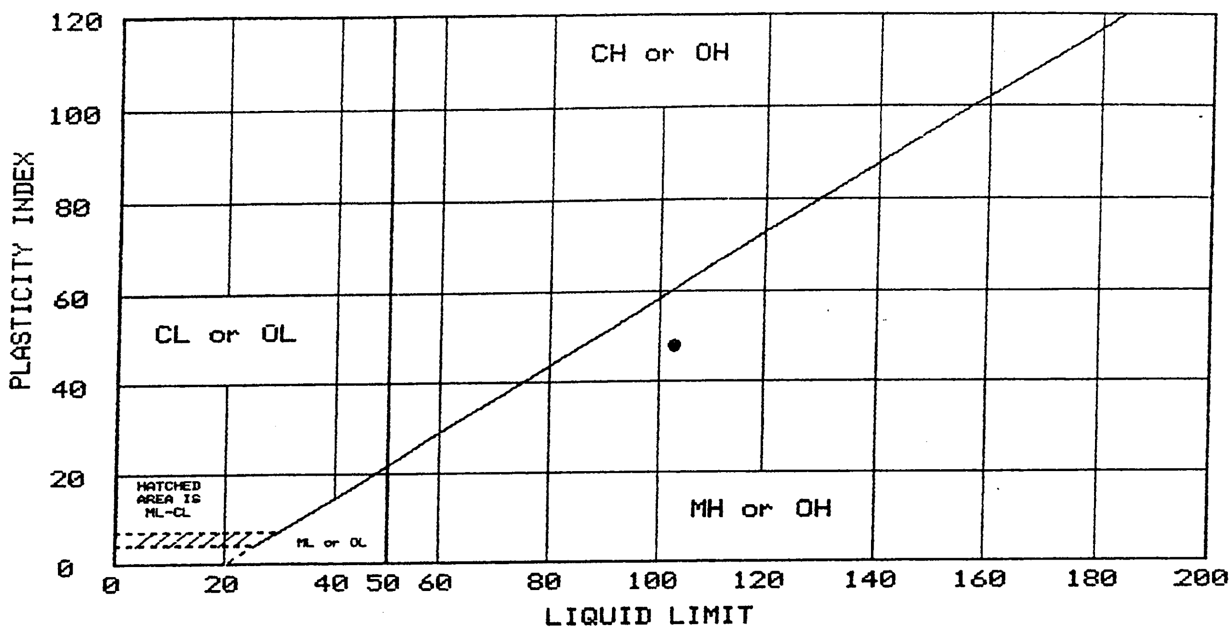
Date: 05-08-97

Remarks:
BOR. CB-MPUC-C10
SAMPLE NO. 2
DEPTH 4.5-6.0'

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Fig. No.________

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	SILT, SAND TRACES, VERY DARK GRAY	103	55	48		**MH**	

Project No.:
Project: MARTIN PENA CHANNEL

Client: ROY F. WESTON
Location: SAN JUAN P.R.

Date: 05-07-97

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MPUC-C10R
DEPTH 4.5-6.0'

Fig. No.______

SEDIMENT SAMPLE DATA SHEET
(COMPOSITE SAMPLE)

SAMPLE NO.: ES-MPUC-1

CLIENT:	**U.S. Army Corps of Engineers**	**DATE:**	**14-Feb-97**
SITE NAME:	**Martin Pena Canal**	**SAMPLE AREA:**	
PROJECT NO.:	**03886-136-005**	**(x)**	**San Jose Lagoon**
CONTRACT NO:	**DACW17-95-D-0017 (DO-5)**	**( )**	**Los Corozos Lagoon**

ALEQUOT NO. 1

Sediment Description: Black organic clay, mucky with sulfur odor.

Sample Location:	ES-MPUC-1A	**Odor:**	Sulfur
Sample Time:	10:10	**OVM Reading:**	2 units
Sample Depth:	34	**Northing:**	213059.7963
Elevation[a]:	-33.69	**Easting:**	644364.6262

ALEQUOT NO. 2

Sediment Description: Black organic clay, mucky with sulfur odor.

Sample Location:	ES-MPUC-1B	**Odor:**	Sulfur
Sample Time:	10:20	**OVM Reading:**	2 units
Sample Depth:	18	**Northing:**	213750.0515
Elevation[a]:	-17.61	**Easting:**	644595.3792

ALEQUOT NO. 3

Sediment Description: Black organic clay, mucky with sulfur odor.

Sample Location:	ES-MPUC-1C	**Odor:**	Sulfur
Sample Time:	10:30	**OVM Reading:**	0 units
Sample Depth:	18	**Northing:**	215053.427
Elevation[a]:	-16.35	**Easting:**	645149.1026

COMPOSITE SAMPLE		**WATER SAMPLE**	
Composite Sample Time:	10:45	**Water Sample Time:**	10:00
Composite Sample No:	ES-MPUC-1	**Water Sample No.:**	ES-MPUC-1
		Sample Location:	ES-MPUC-1A
		Sample Depth (ft):	3 FEET

Sample depths are given in feet below top of water.

[a]Elevations are provided in feet from mean sea level for the top of sediment.

SEDIMENT SAMPLE DATA SHEET
(COMPOSITE SAMPLE)

SAMPLE NO.: ES-MPUC-2

CLIENT:	U.S. Army Corps of Engineers	DATE:	14-Feb-97
SITE NAME:	Martin Pena Canal	SAMPLE AREA:	
PROJECT NO.:	03886-136-005	( )	San Jose Lagoon
CONTRACT NO:	DACW17-95-D-0017 (DO-5)	(X)	Los Corozos Lagoon

ALEQUOT NO. 1

Sediment Description: Black organic clay, mucky with sulfur odor.

Sample Location:	ES-MPUC-2A	Odor:	Sulfur
Sample Time:	11:35	OVM Reading:	1 units
Sample Depth:	8	Northing:	220403.2907
Elevation[a]:	-6.36	Easting:	636620.6885

ALEQUOT NO. 2

Sediment Description: Black organic clay, mucky with sulfur odor.

Sample Location:	ES-MPUC-2B	Odor:	Sulfur
Sample Time:	11:48	OVM Reading:	3 units
Sample Depth:	19	Northing:	220236.3322
Elevation[a]:	-19.48	Easting:	636684.1182

COMPOSITE SAMPLE

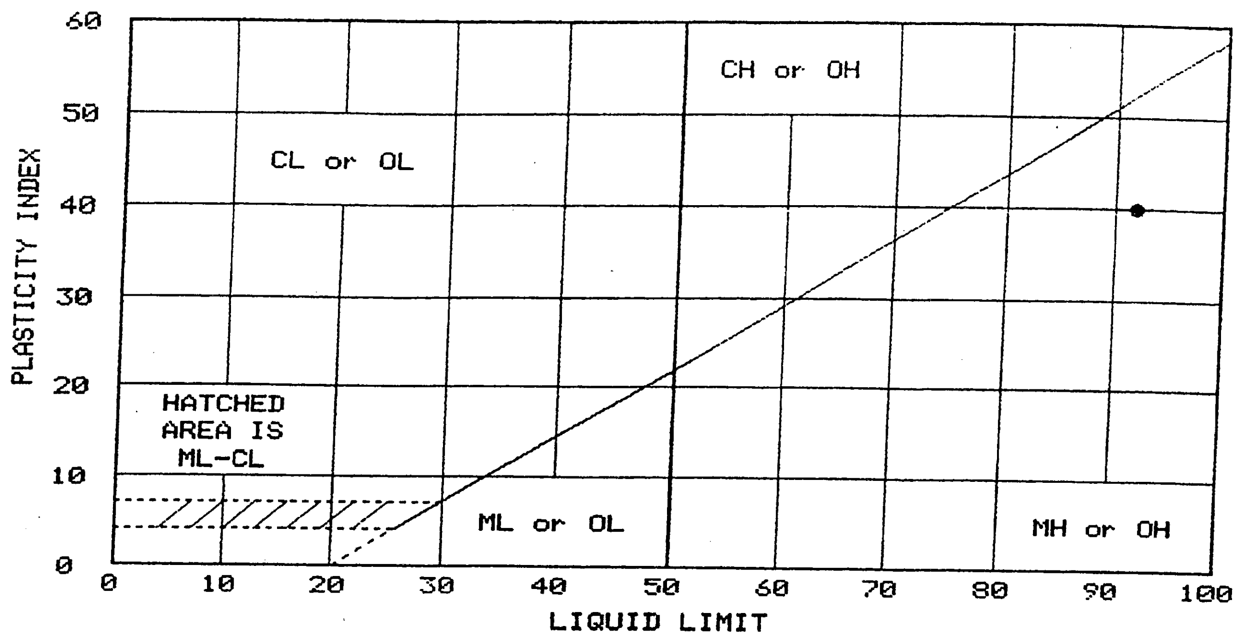
Composite Sample Time:	12:00
Composite Sample No:	ES-MPUC-2

WATER SAMPLE

Water Sample Time:	11:25
Water Sample No.:	ES-MPUC-2
Sample Location:	ES-MPUC-2A
Sample Depth (ft):	3 FEET

Sample depths are given in feet below top of water.
[a]Elevations are provided in feet from mean sea level for the top of sediment.

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	USCS	AASHTO
● SILT, SAND TRACES, VERY DARK GRAY	92	52	40		MH	

Project No.:
Project: MARTIN PENA CHANNEL

Client: ROY F. WESTON
Location: SAN JUAN P.R.

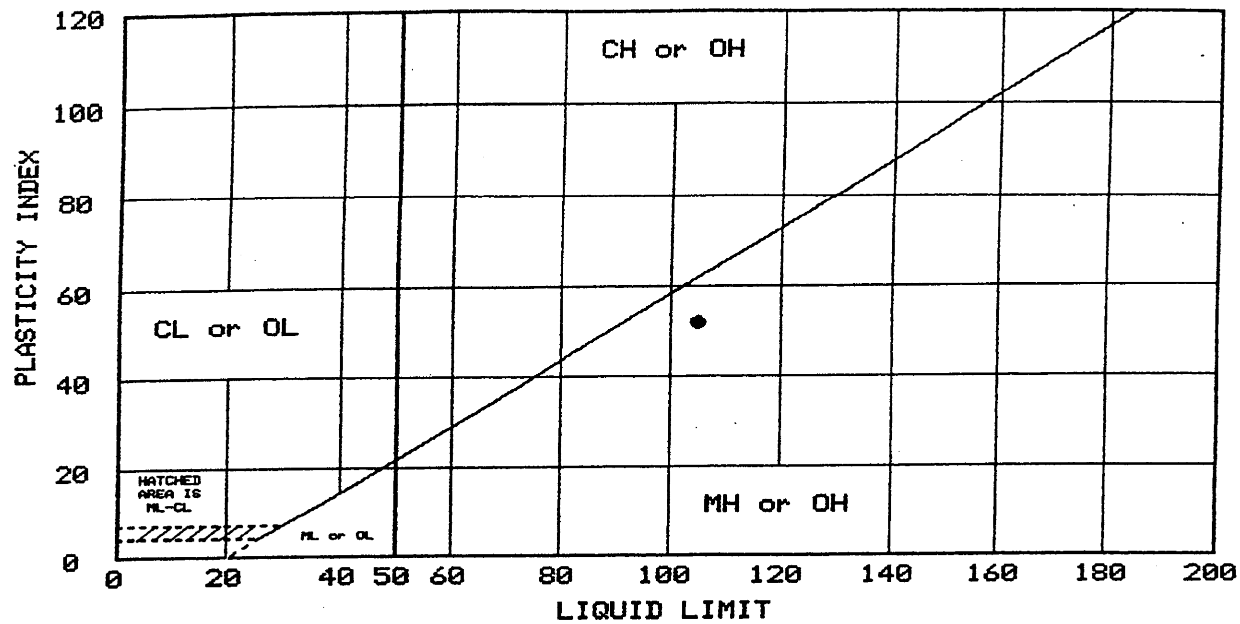
Date: 05-07-97

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MPUC-C1
SAMPLE NO. 2
DEPTH 6.5-8.0'

Fig. No.______

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	CLAYEY SILT,GRAY AND BROWN	105	53	52		MH	

Project No.:
Project: MARTIN PENA CHANNEL

Client:
Location: SAN JUAN P.R.

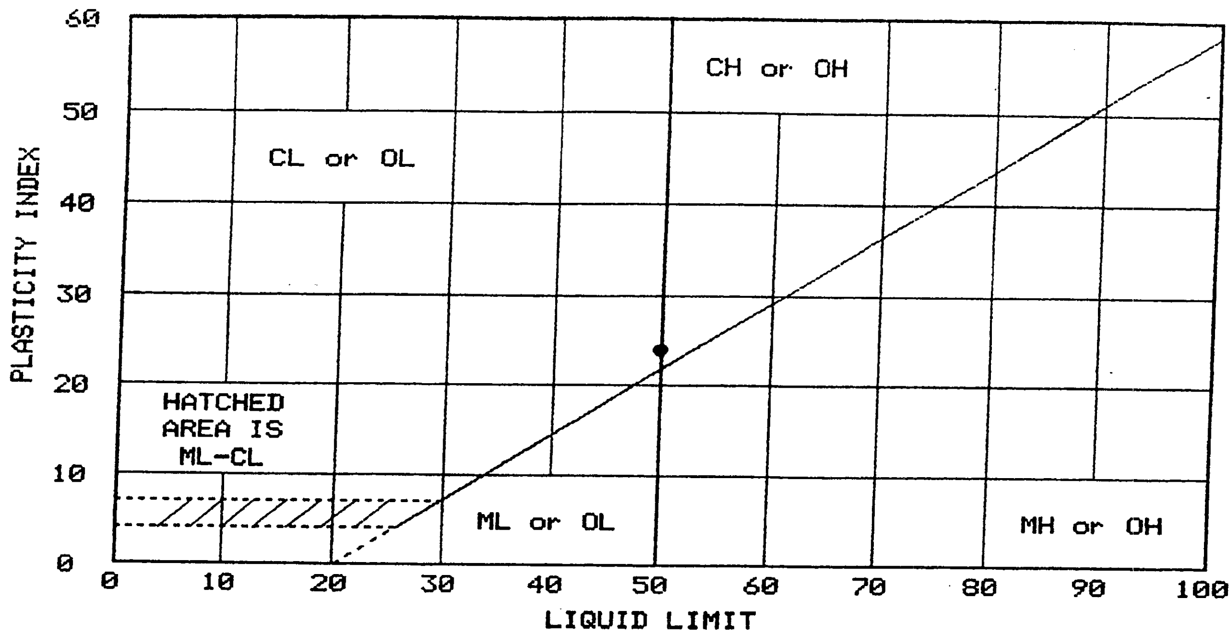
Date: 05-02-97

Remarks:
BOR. CB-MPUC-C2
SAMPLE NO. 3
DEPTH 7.0-8.5'

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Fig. No.______

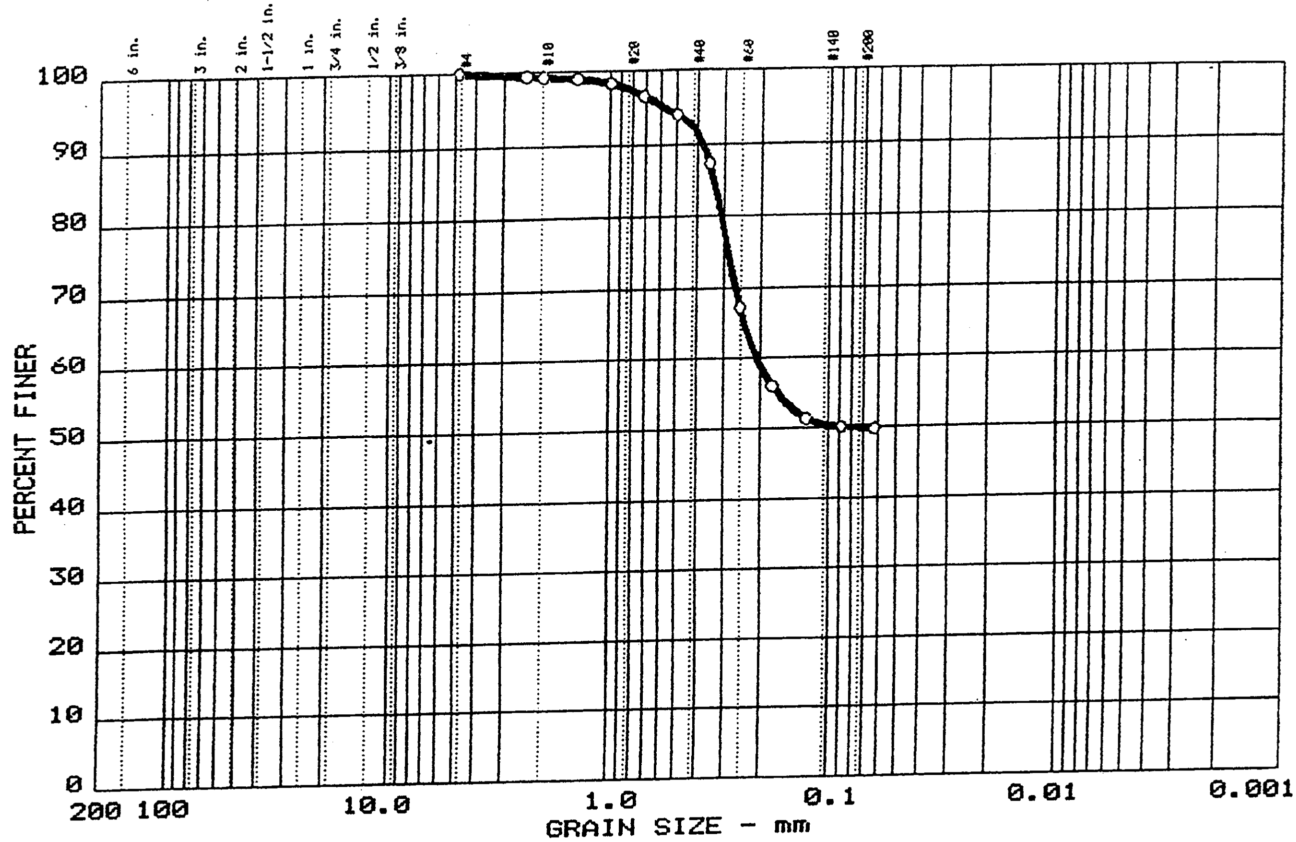
LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	USCS	AASHTO
● SANDY CLAY, OLIVE BROWN	50	26	24		CL	

Project No.: Project: MARTIN PENA CHANNEL Client: ROY F. WESTON Location: SAN JUAN P.R. Date: 05-03-97	Remarks: BOR. CB-MPUC-C3 SAMPLE NO. 3 DEPTH 9.0'TO 10.5'
LIQUID AND PLASTIC LIMITS TEST REPORT **SUELOS INC.**	Fig. No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	50.1	49.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.33	0.21	0.08					

MATERIAL DESCRIPTION	USCS	AASHTO
○ SILTY SAND, VERY DARK GRAY	SM	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN PR.

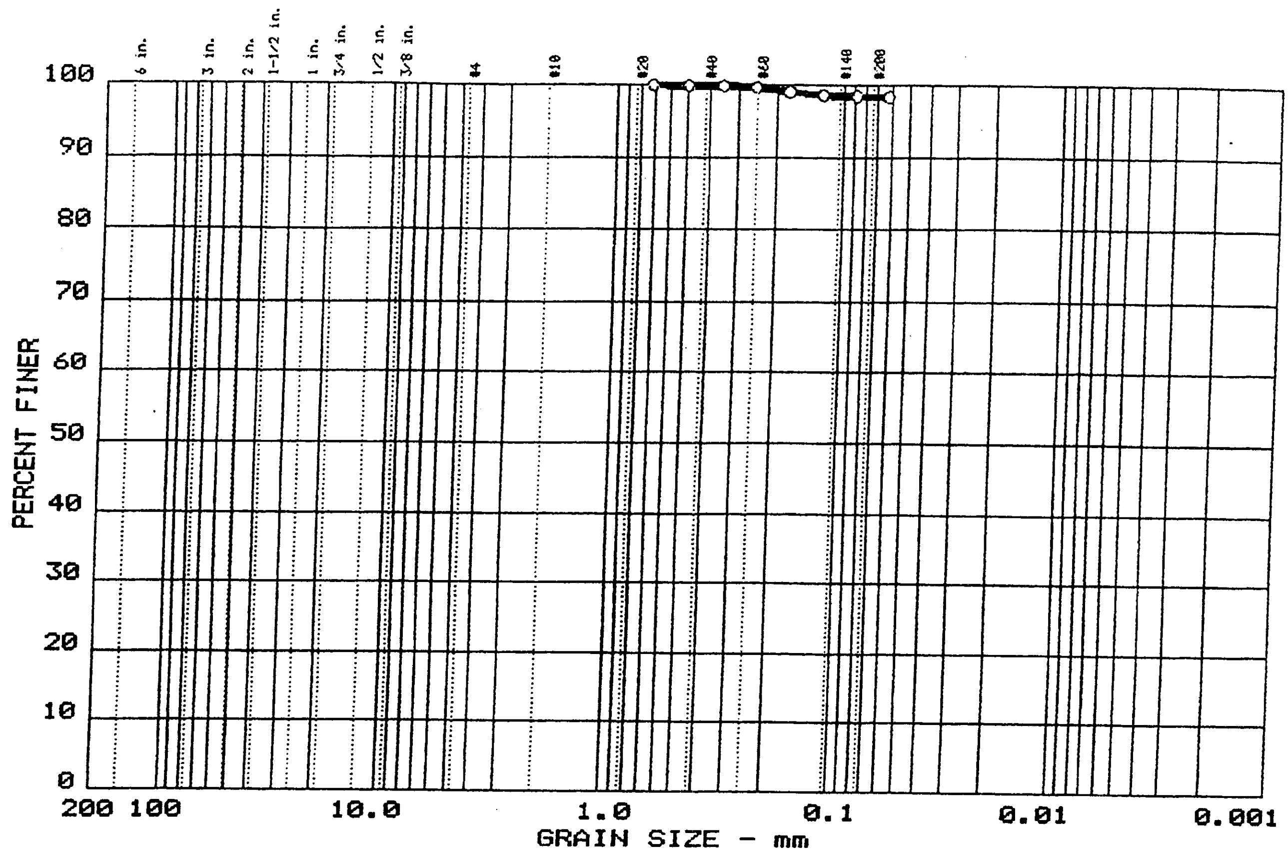
Date: 05-03-97

Remarks:
BOR.CB-MPUC-C4
SAMPLE: 4
DEPTH 9.5' TO 11.0'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	1.6	98.4	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

MATERIAL DESCRIPTION	USCS	AASHTO
○ ORGANIC SILT, VERY DARK GRAY	OH	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN PR.

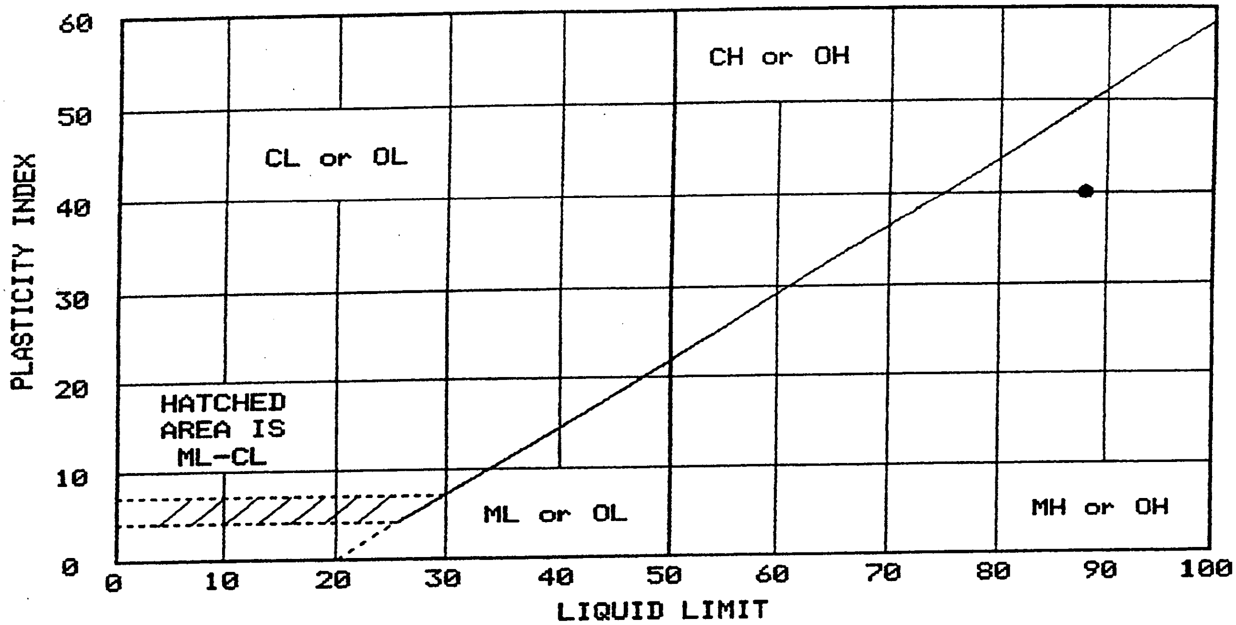
Date: 05-08-97

Remarks:
BOR. CB-MPUC-C5
SAMPLE NO. 2
DEPTH 7.5-9.0'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	ORGANIC SILT, VERY DARK GRAY	88	48	40		OH	

Project No.:
Project: MARTIN PENA CHANNEL

Client:
Location: SAN JUAN P.R.

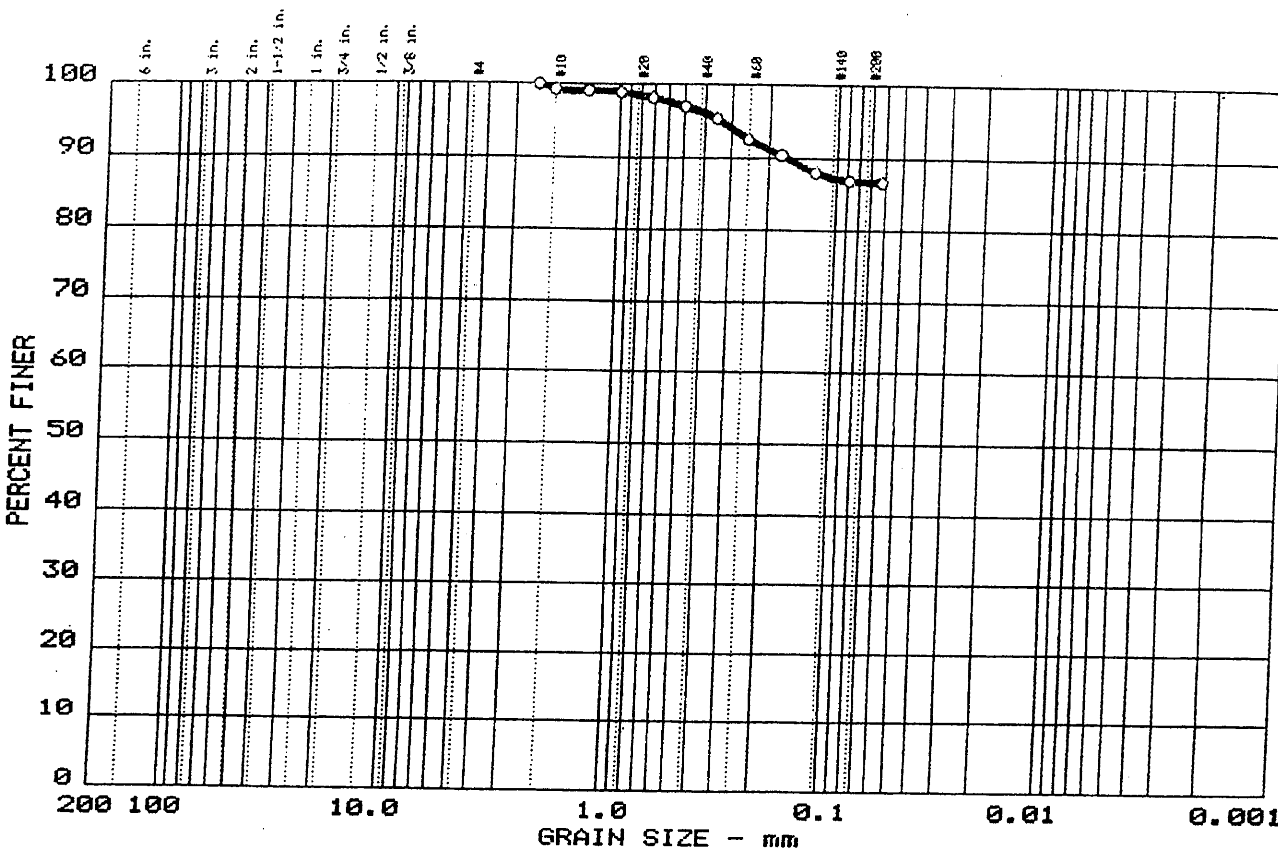
Date: 05-08-97

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MPUC-C5
SAMPLE NO. 2
DEPTH 7.5-9.0'

Fig. No.________

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	13.3	86.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	44	20								

MATERIAL DESCRIPTION	USCS	AASHTO
○ CLAY, LITTLE SAND, RED AND GRAY	CL	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN PR.

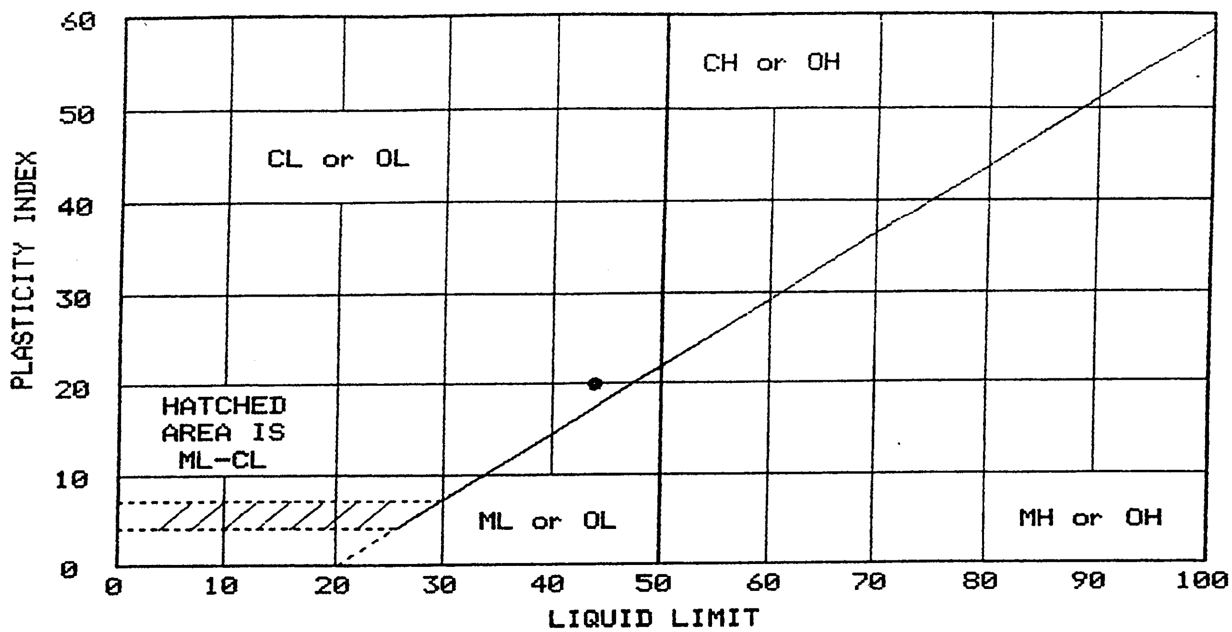
Date: 05-03-97

Remarks:
BOR.CB-MPUC-C7
SAMPLE: 2
DEPTH 7.5' TO 9.0'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	CLAY, LITTLE SAND, RED AND GRAY	44	24	20		CL	

Project No.:
Project: MARTIN PENA CHANNEL

Client: ROY F. WESTON
Location: SAN JUAN P.R.

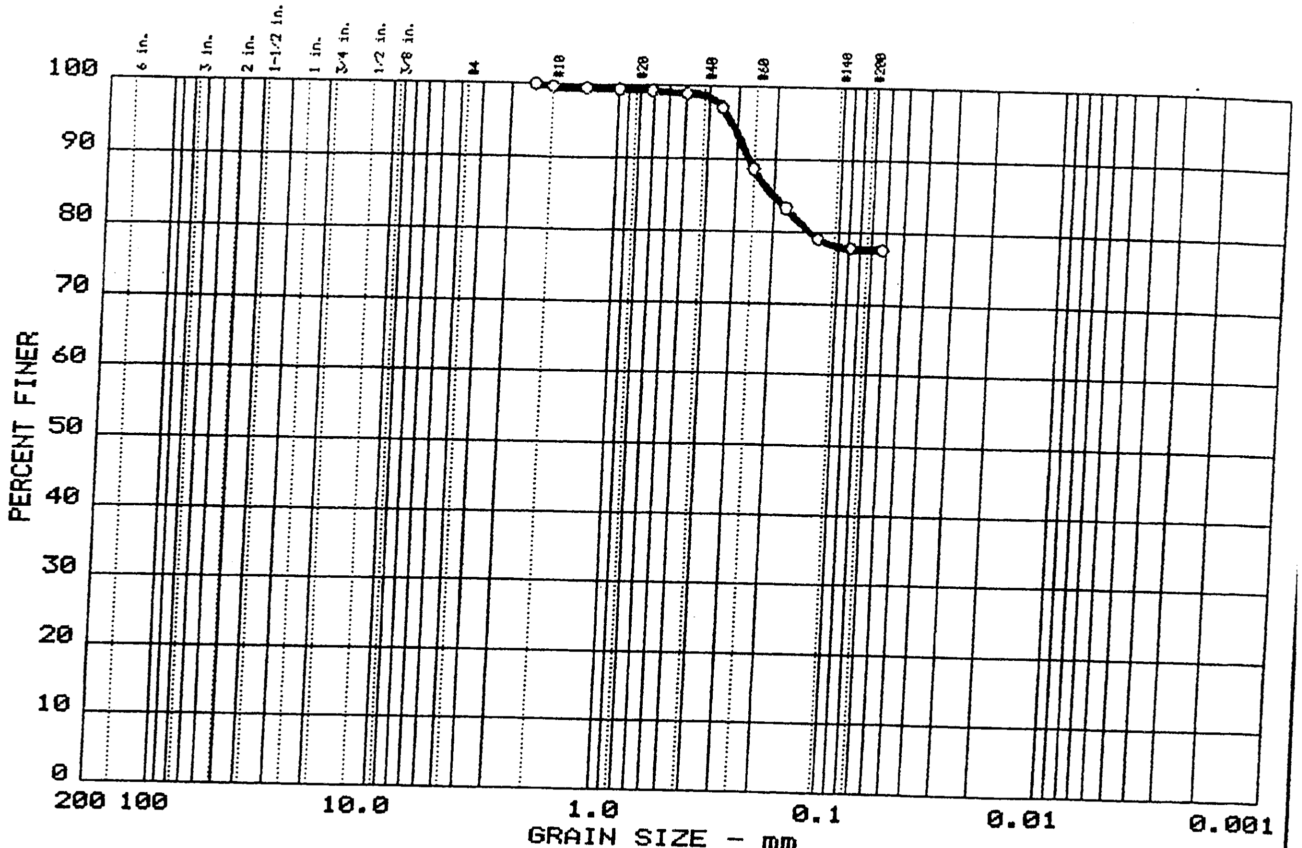
Date: 05-03-97

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MPUC-C7
SAMPLE NO. 2
DEPTH 7.5 TO 9.0'

Fig. No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	22.3	77.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	56	27	0.20							

MATERIAL DESCRIPTION	USCS	AASHTO
○ CLAY,LITTLE SAND,GRAY AND RED	CH	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN PR.

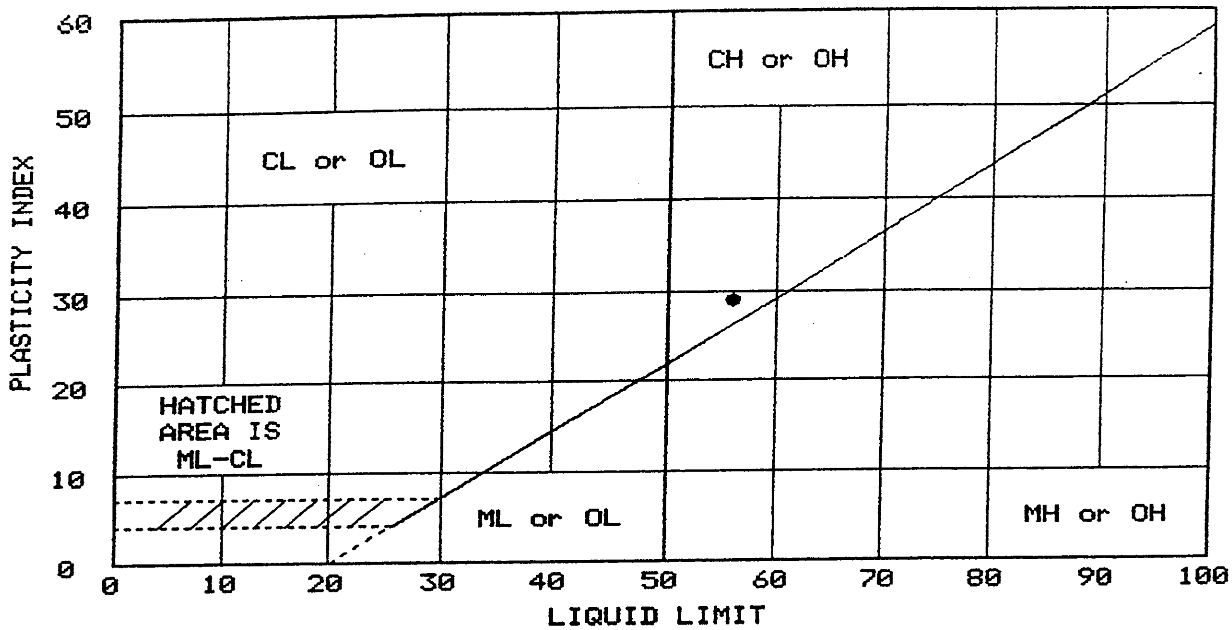
Date: 05-03-97

Remarks:
BOR.CB-MPUC-C7
SAMPLE: 3
DEPTH 9.0'TO 10.5'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	CLAY, LITTLE SAND, GRAY & RED	56	27	29		CH	

Project No.:
Project: MARTIN PENA CHANNEL

Client: ROY F. WESTON
Location: SAN JUAN P.R.

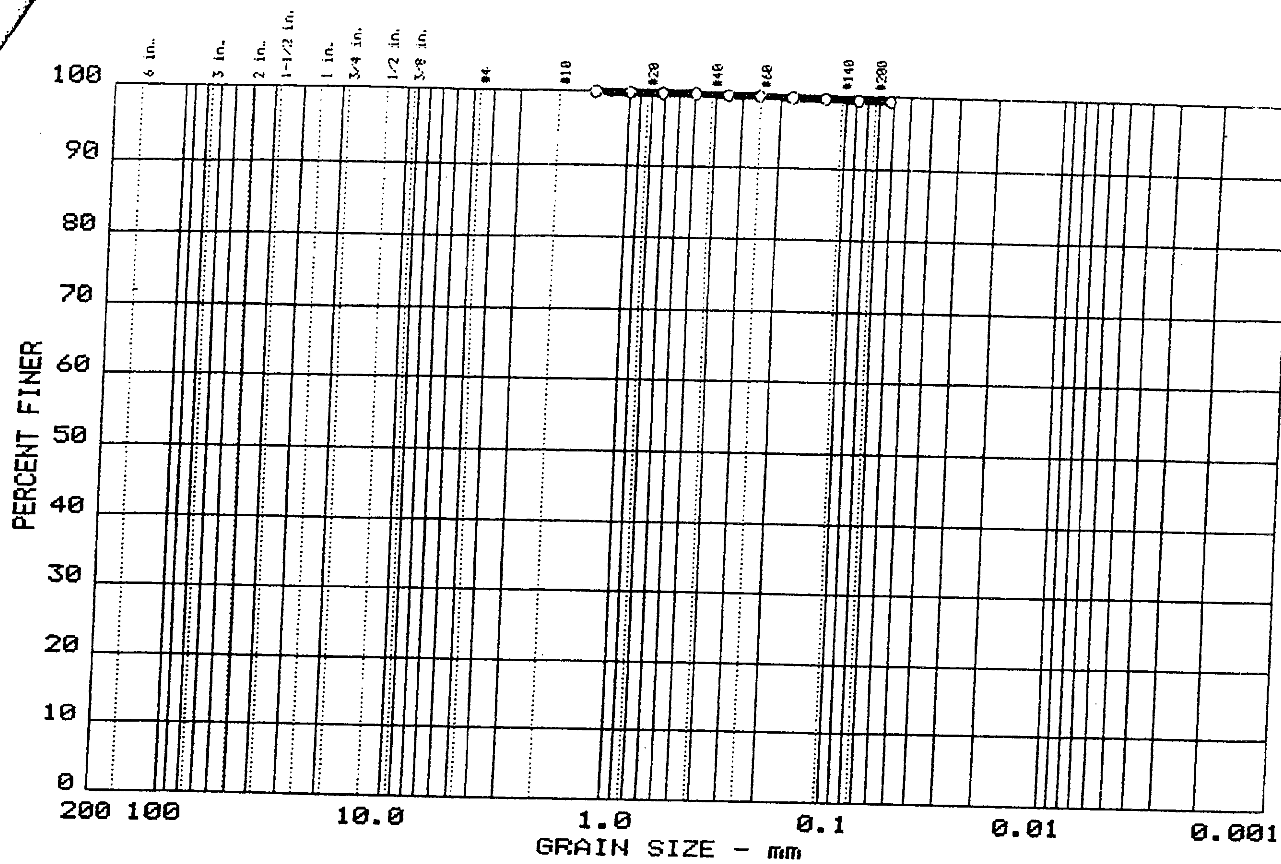
Date: 05-03-97

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MPUC-C7
SAMPLE NO. 3
DEPTH 9.0 TO 10.5'

Fig. No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	0.6	99.4	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

MATERIAL DESCRIPTION	USCS	AASHTO
○ ORGANIC SILT, VERY DARK GRAY	OH	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN PR.

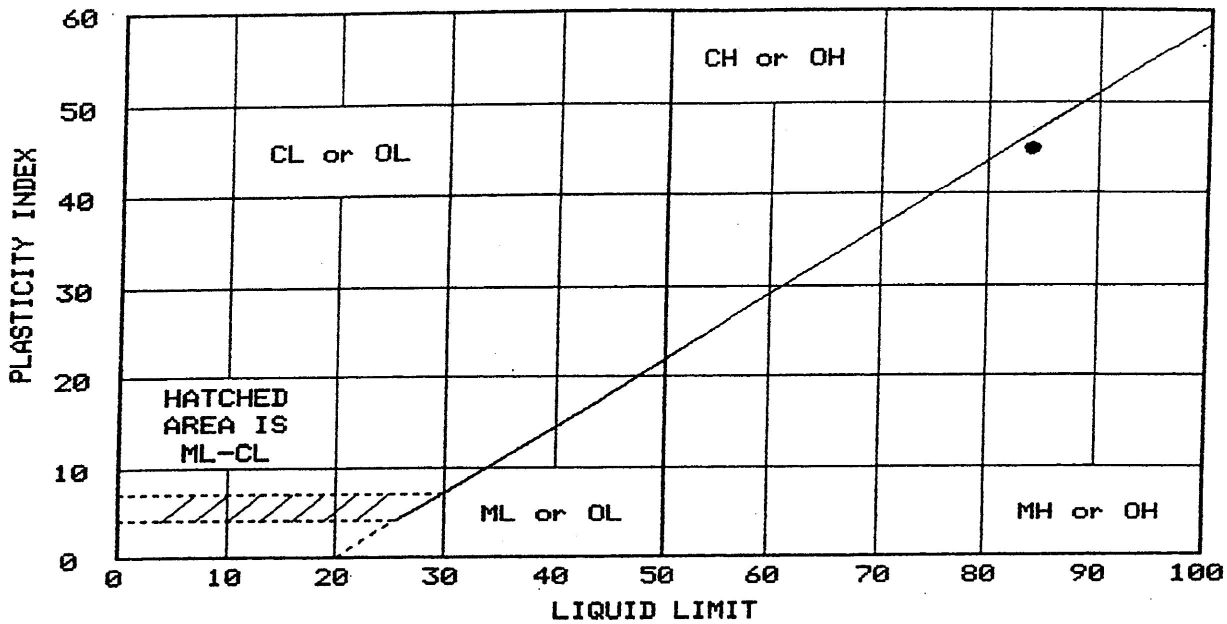
Date: 05-07-97

Remarks:
BOR. CB-MPUC-C8
SAMPLE NO. 2
DEPTH 5.5-7.0'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	CLAYEY SILT, SOME SAND, YELLOWISH BROWN	84	39	45		MH	

Project No.:
Project: MARTIN PENA CHANNEL

Client:
Location: SAN JUAN P.R.

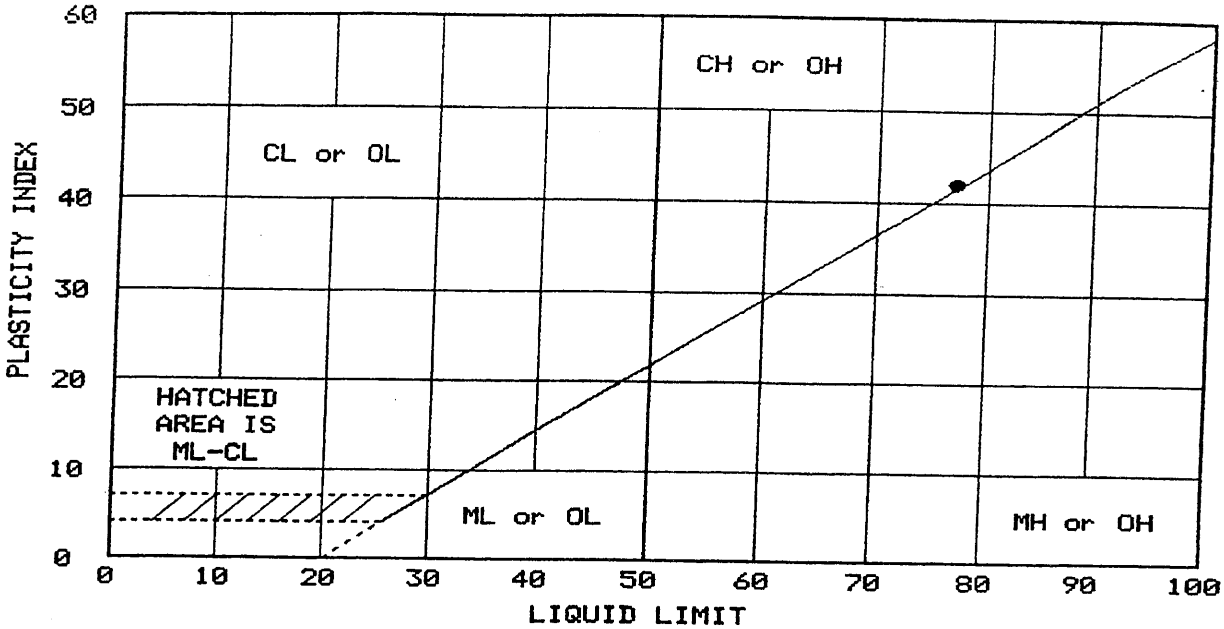
Date: 05-01-97

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MPUC-L1
SAMPLE NO. 19
DEPTH 27.0-28.5'

Fig. No.________

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	USCS	AASHTO
● CLAY,SAND TRACES,RED	77	35	42		CH	

Project No.:
Project: MARTIN PENA CHANNEL

Client: ROY F. WESTON
Location: SAN JUAN P.R.

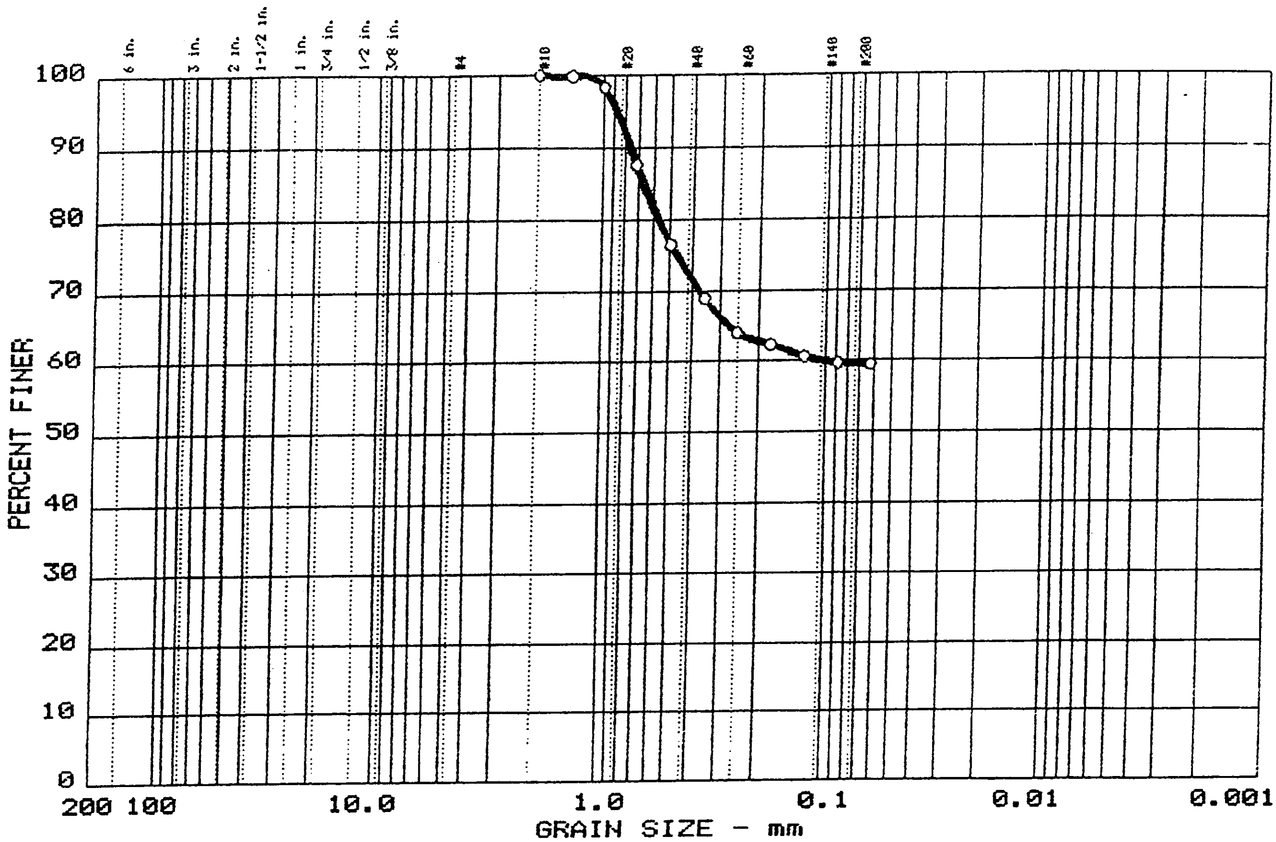
Date: 05-01-97

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MPUC-L1
SAMPLE NO. 22
DEPTH 31.5'to 33.0'

Fig. No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	40.5	59.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.66	0.10						

MATERIAL DESCRIPTION	USCS	AASHTO
○ SANDY SILT, YELLOWISH BROWN	ML	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: CB-MPUC-L1, SAMPLE 29, DEPTH 42-43.5'

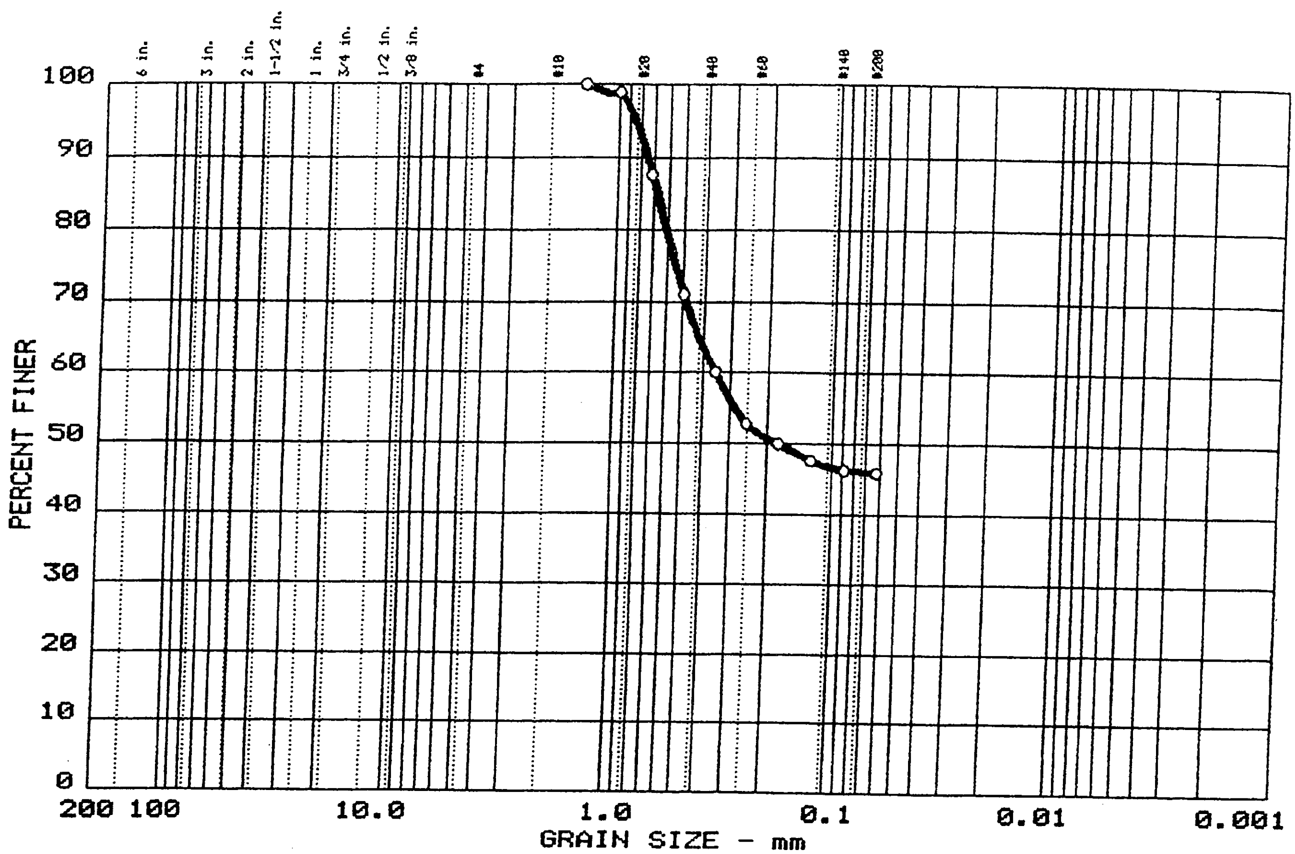
Date: 05-01-97

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	53.9	46.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.67	0.35	0.18					

MATERIAL DESCRIPTION	USCS	AASHTO
○ SILTY SAND, YELLOW	SM	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: CB-MPUC-L1, SAMPLE 40, DEPTH 57-58.5'

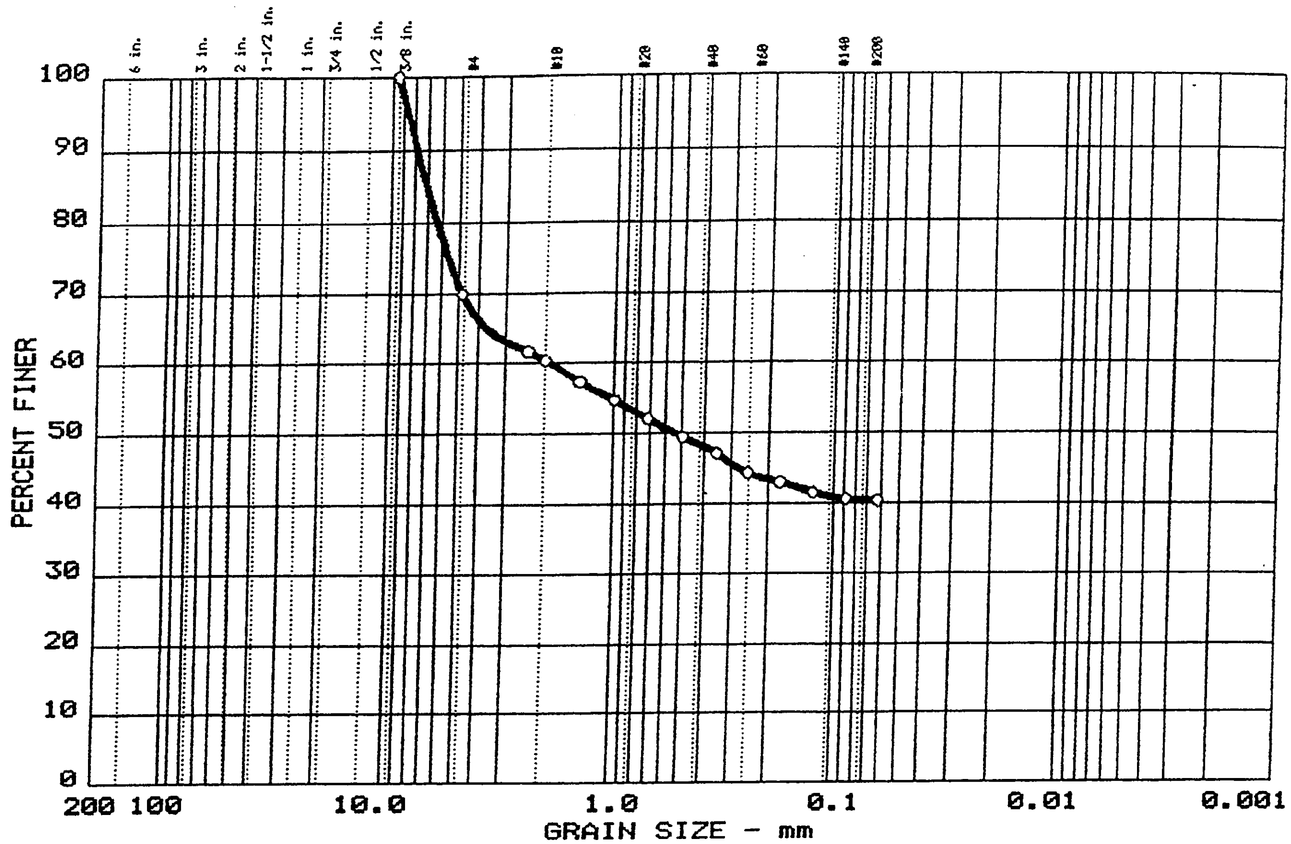
Date: 05-01-97

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	30.1	29.5	40.4	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			7.06	1.90	0.54					

MATERIAL DESCRIPTION	USCS	AASHTO
○ GRAVELLY SANDY CLAY, OLIVE AND BROWNISH GRAY	CL	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: CB-MPUC-L2, SAMPLE 3, DEPTH 3-4.5'

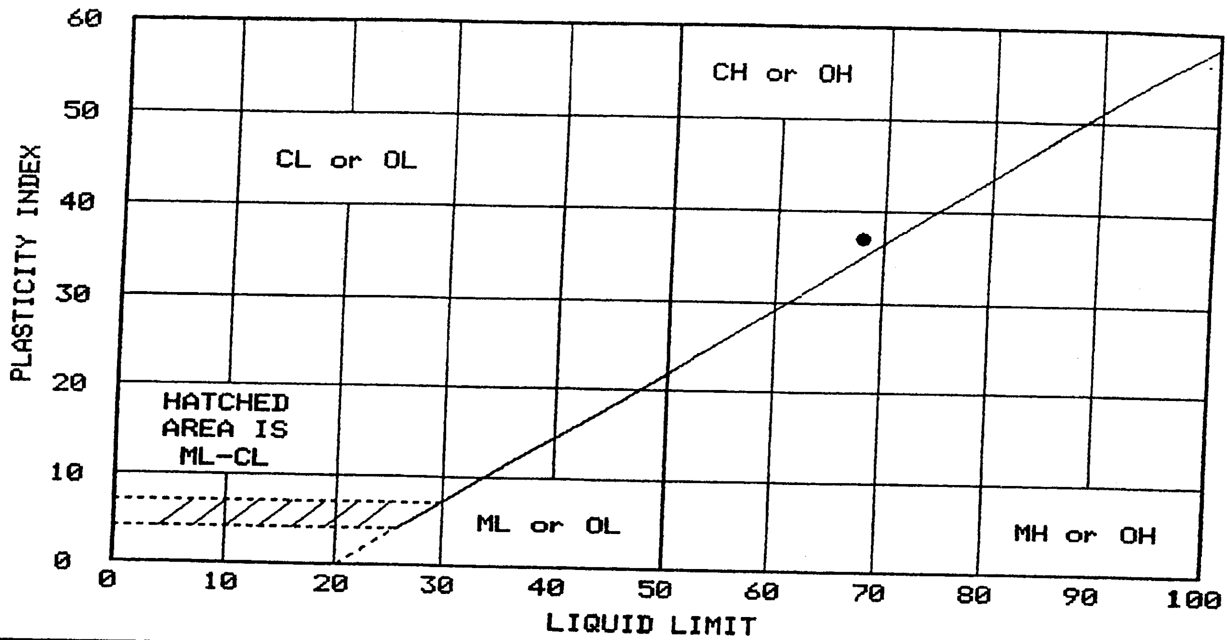
Date: 05-01-97

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:

Figure No.______

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	USCS	AASHTO
● SILTY CLAY, SAND TRACES, GRAYISH BROWN	68	31	37		CH	

Project No.:
Project: MARTIN PENA CHANNEL

Client:
Location: SAN JUAN P.R.

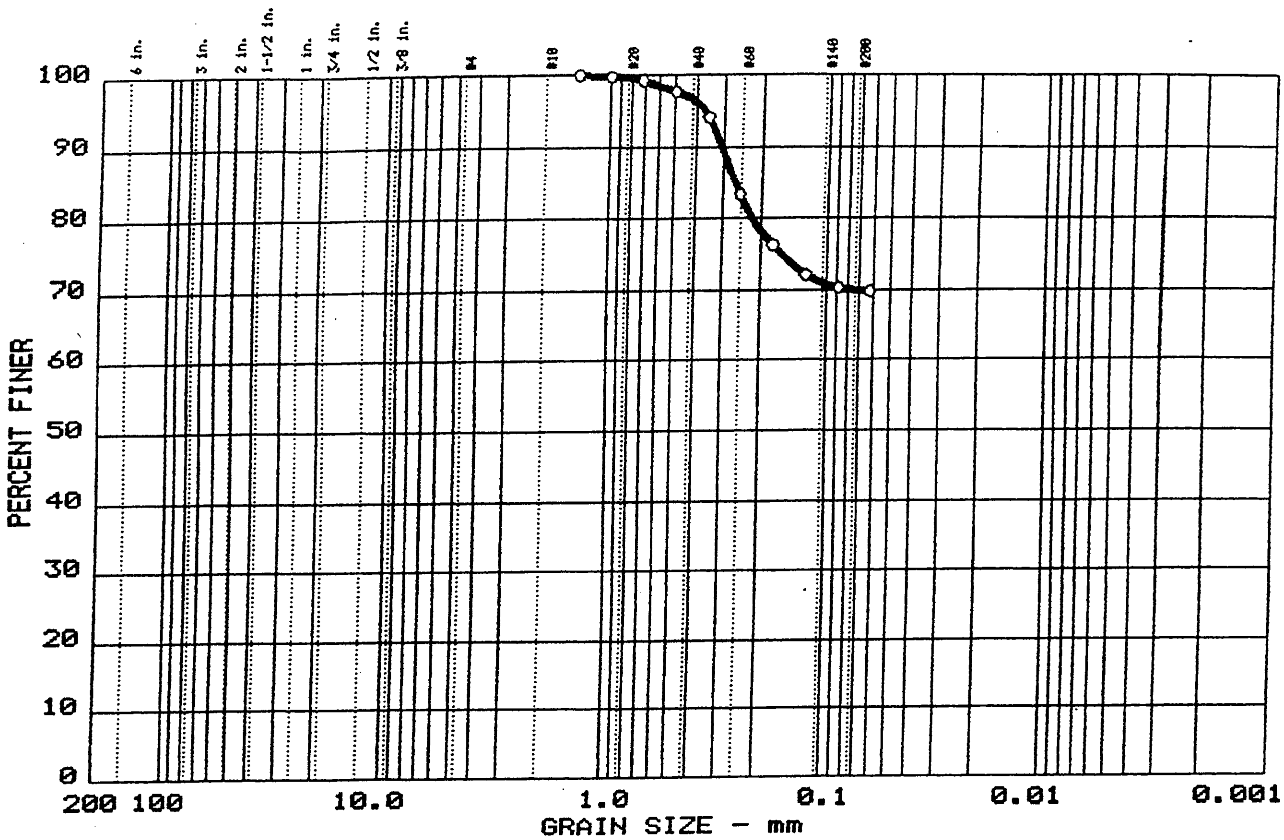
Date: 04-29-97

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MPUC-L2
SAMPLE NO. 11
DEPTH 15.0-16.5'

Fig. No.____

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75 mm	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	0.0	30.1	69.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o			0.26							

MATERIAL DESCRIPTION	USCS	AASHTO
o CLAY, SOME SAND, GRAY	CL	

Project No.:
Project: MARTIN PENA CHANNEL
o Location: SAN JUAN P.R.

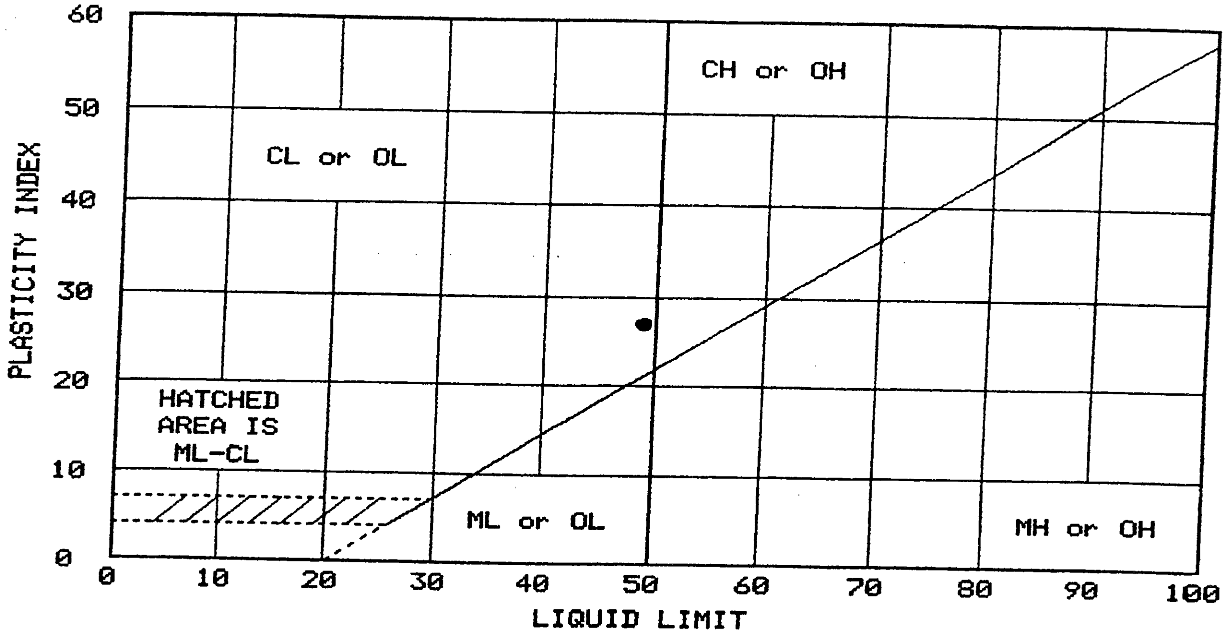
Date: 05-01-97

Remarks:
BOR. CB-MPUC-L1
SAMPLE NO. 9
DEPTH 12.0-13.5'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	CLAY, SOME SAND, GRAY	49	22	27		CL	

Project No.:
Project: MARTIN PENA CHANNEL

Client:
Location: SAN JUAN P.R.

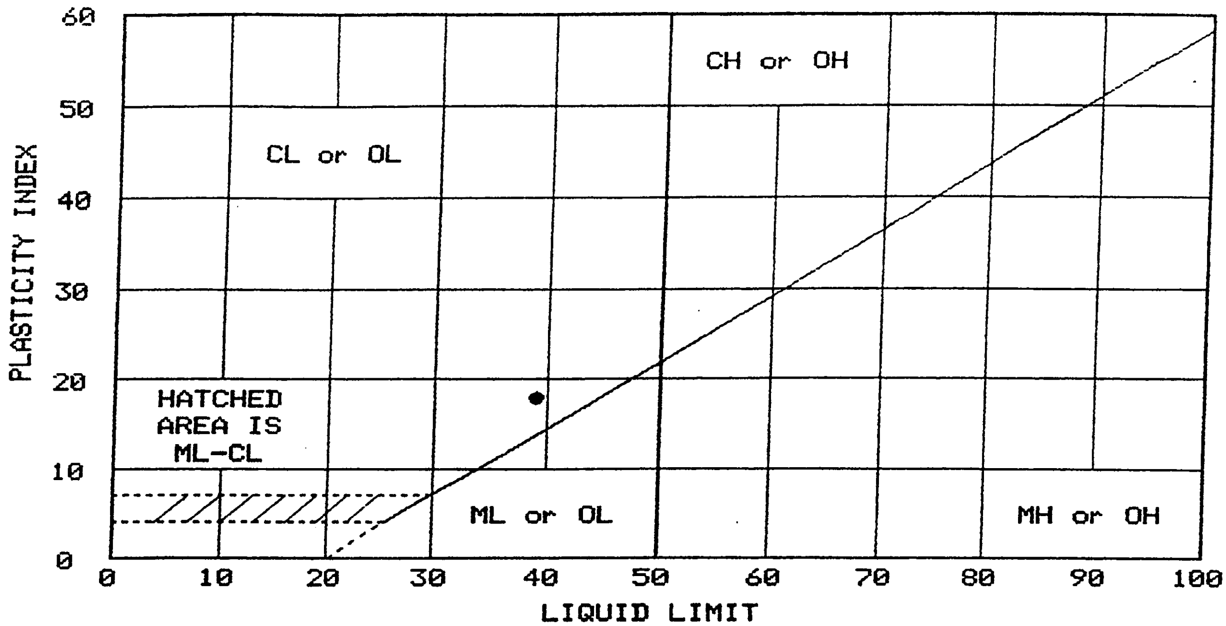
Date: 05-01-97

Remarks:
BOR. CB-MPUC-L1
SAMPLE NO. 9
DEPTH 12.0-13.5'

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Fig. No.____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	SANDY CLAY, DARK OLIVE BROWN	39	21	18		CL	

Project No.:
Project: MARTIN PENA CHANNEL

Client: ROY F. WESTON
Location: SAN JUAN P.R.

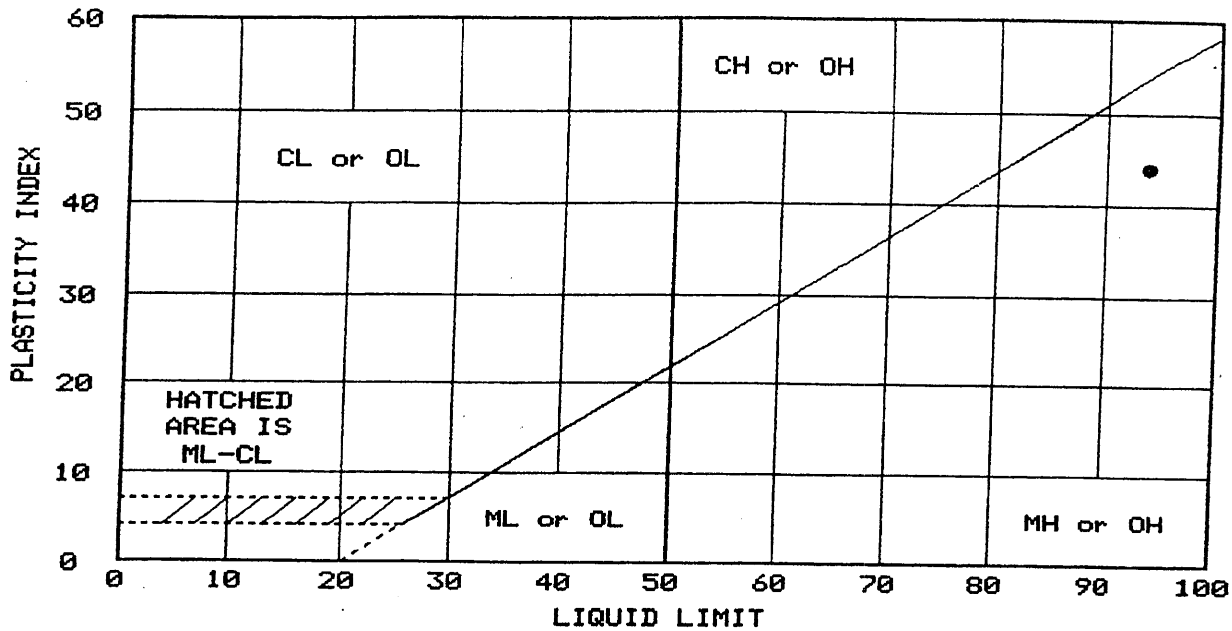
Date: 04-30-97

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MPUC-L1
SAMPLE NO. 12
DEPTH 16.5' to 18.0'

Fig. No.______

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	USCS	AASHTO
● CLAYEY SILT, SAND TRACES, GRAY AND YELLOWISH RED	94	50	44		MH	

Project No.:
Project: MARTIN PENA CHANNEL

Client:
Location: SAN JUAN P.R.

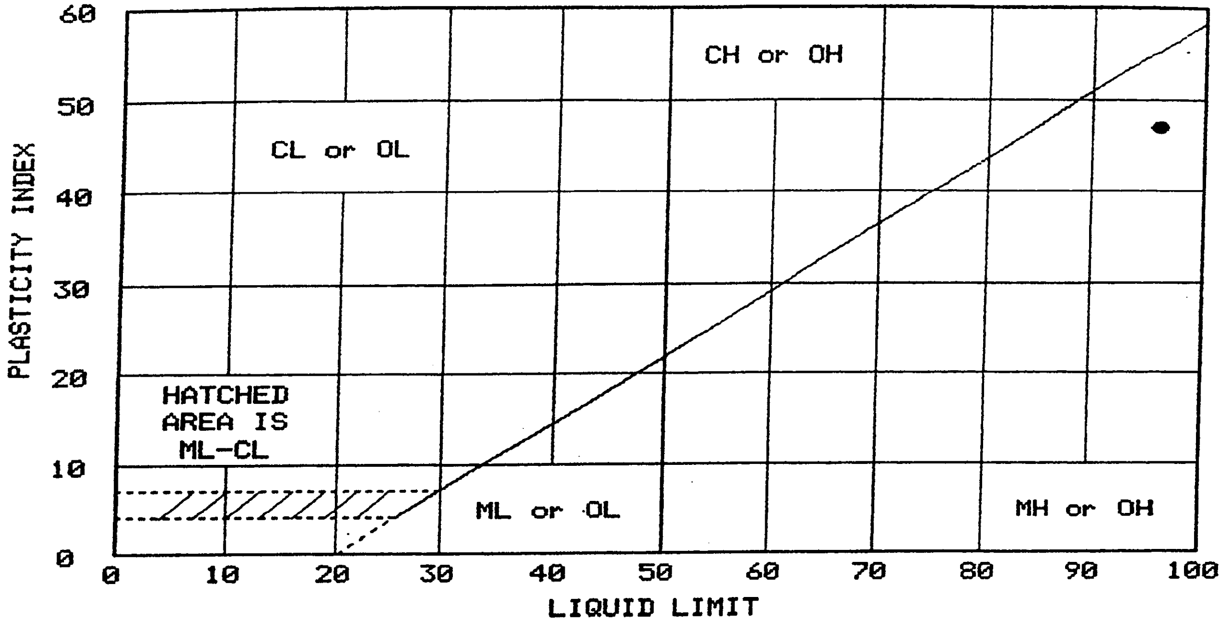
Date: 04-30-97

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MPUC-L1
SAMPLE NO. 16
DEPTH 22.5-24.0'

Fig. No.______

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	USCS	AASHTO
● SILT, YELLOWISH BROWN	96	49	47		MH	

Project No.:
Project: MARTIN PENA CHANNEL

Client:
Location: SAN JUAN P.R.

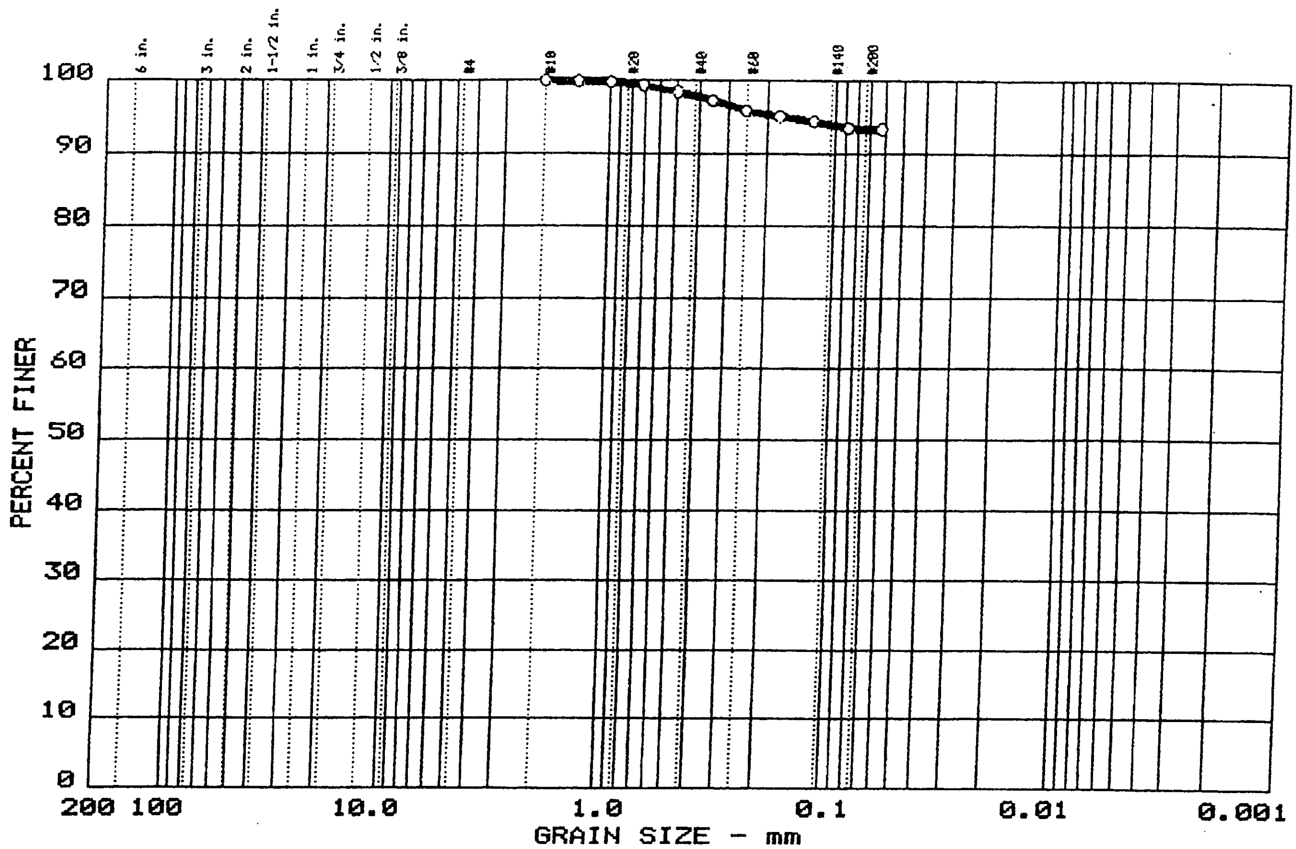
Date: 04-29-97

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MPUC-L2
SAMPLE NO. 13
DEPTH 18.0-19.5'

Fig. No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75 mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	6.6	93.4	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

MATERIAL DESCRIPTION	USCS	AASHTO
○ CLAYEY SILT, TRACE SAND, RED	ML	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: CB-MPUC-L2, SAMPLE 16, DEPTH 22.5-24'

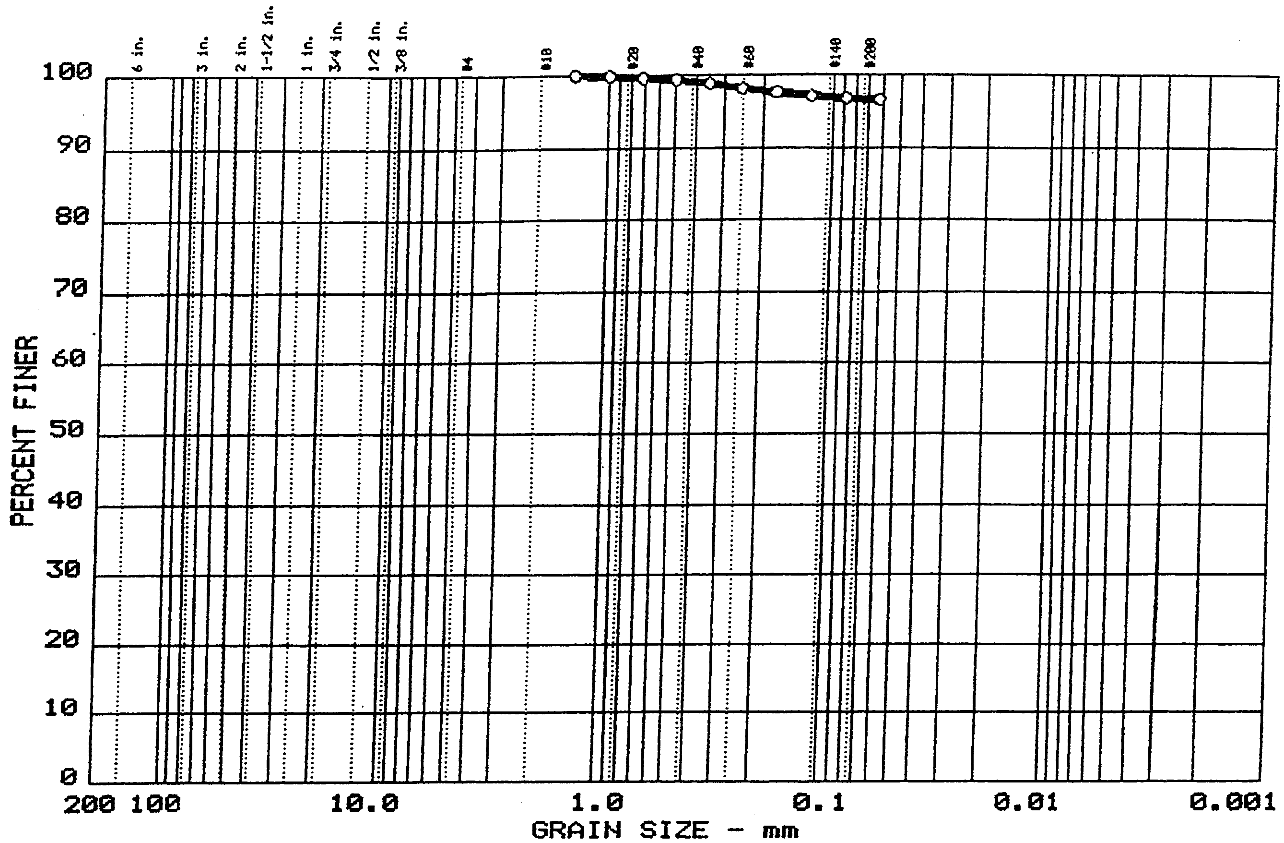
Date: 05-01-97

Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	3.3	96.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

MATERIAL DESCRIPTION	USCS	AASHTO
○ SILTY CLAY, TRACE SAND, RED	CL	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: CB-MPUC-L2, SAMPLE 18, DEPTH 25.5-27'

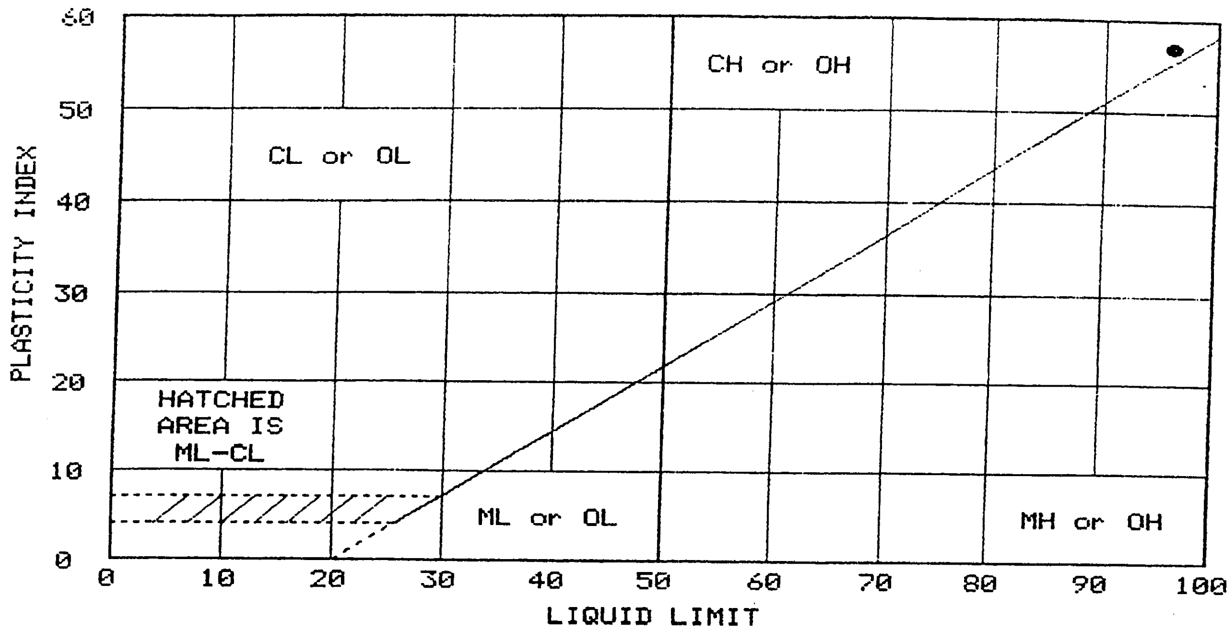
Date: 05-01-97

Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	SILTY CLAY, SAND TRACES, RED	96	39	57		CH	

Project No.:
Project: MARTIN PENA CHANNEL

Client: ROY F. WESTON
Location: SAN JUAN P.R.

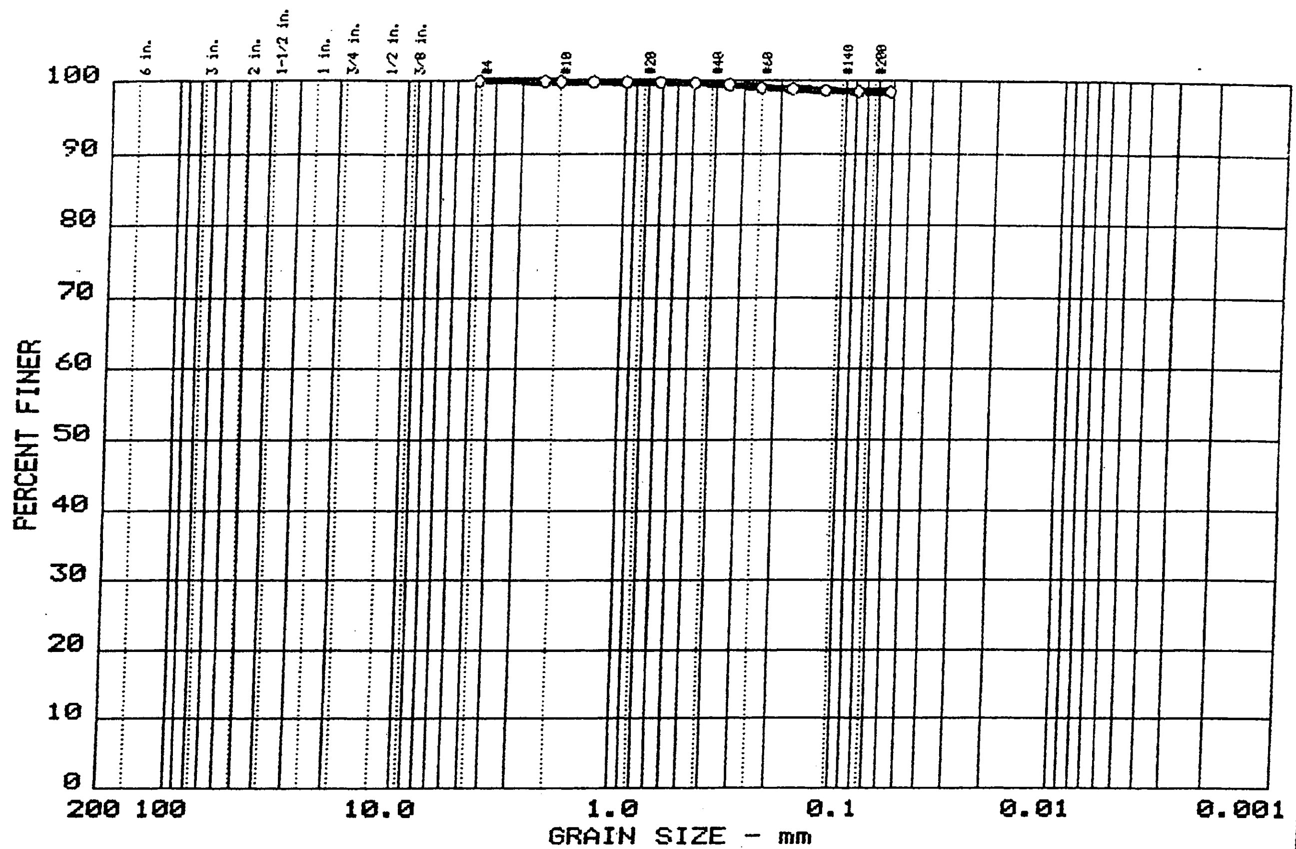
Date: 04-30-97

Remarks:
BOR. CB-MPUC-L2
SAMPLE NO. 18
DEPTH 25.5 TO 27.0'

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Fig. No. ______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	1.5	98.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

MATERIAL DESCRIPTION	USCS	AASHTO
○ SILTY CLAY,TRACE SAND,YELLOWISH RED	CL	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: CB-MPUC-L2,SAMPLE 22,DEPTH 31.5-33'

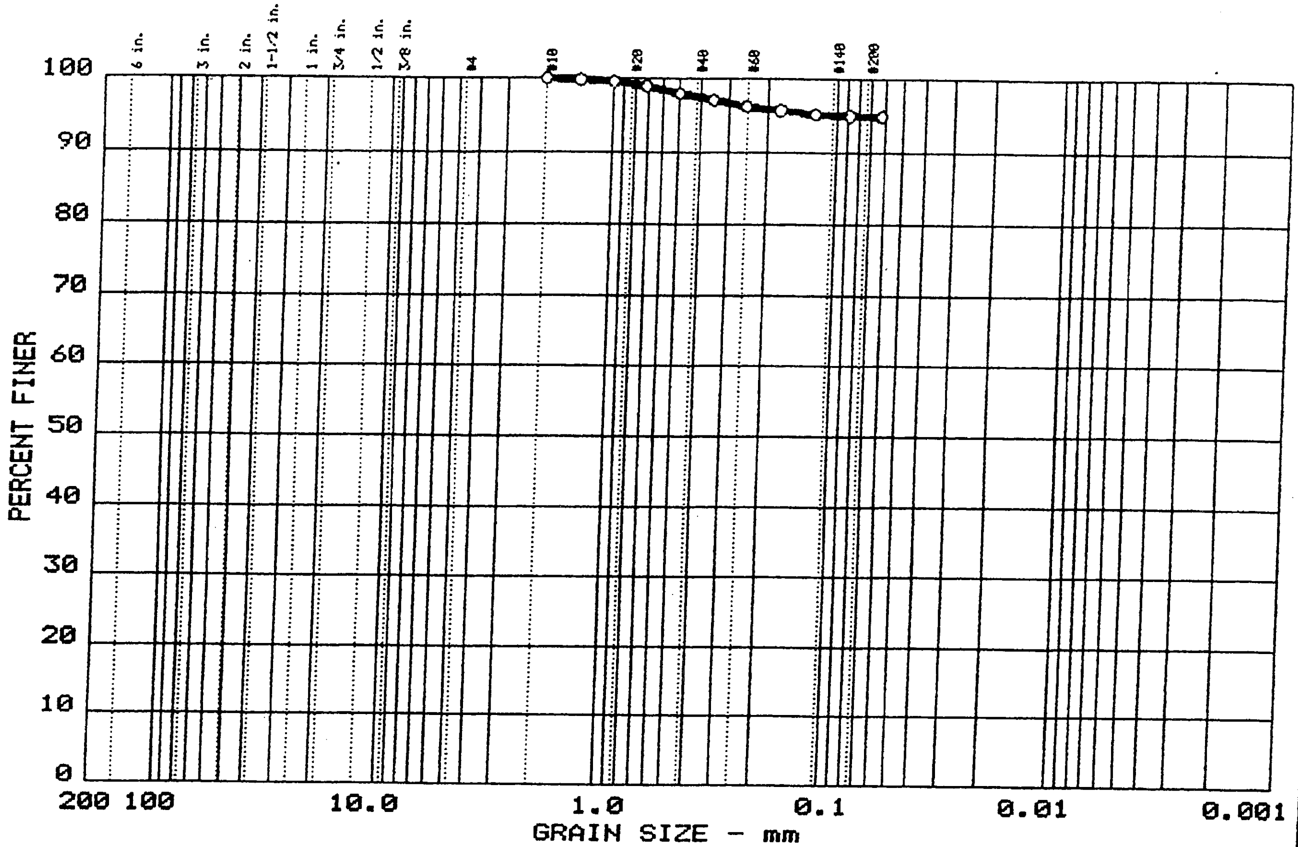
Date: 05-01-97

Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	5.0	95.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

MATERIAL DESCRIPTION	USCS	AASHTO
○ SILTY CLAY,SAND TRACES,YELLOWISH RED	CL	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: CB-MPUC-L2,SAMPLE 28,DEPTH 40.5-42'

Date: 05-01-97

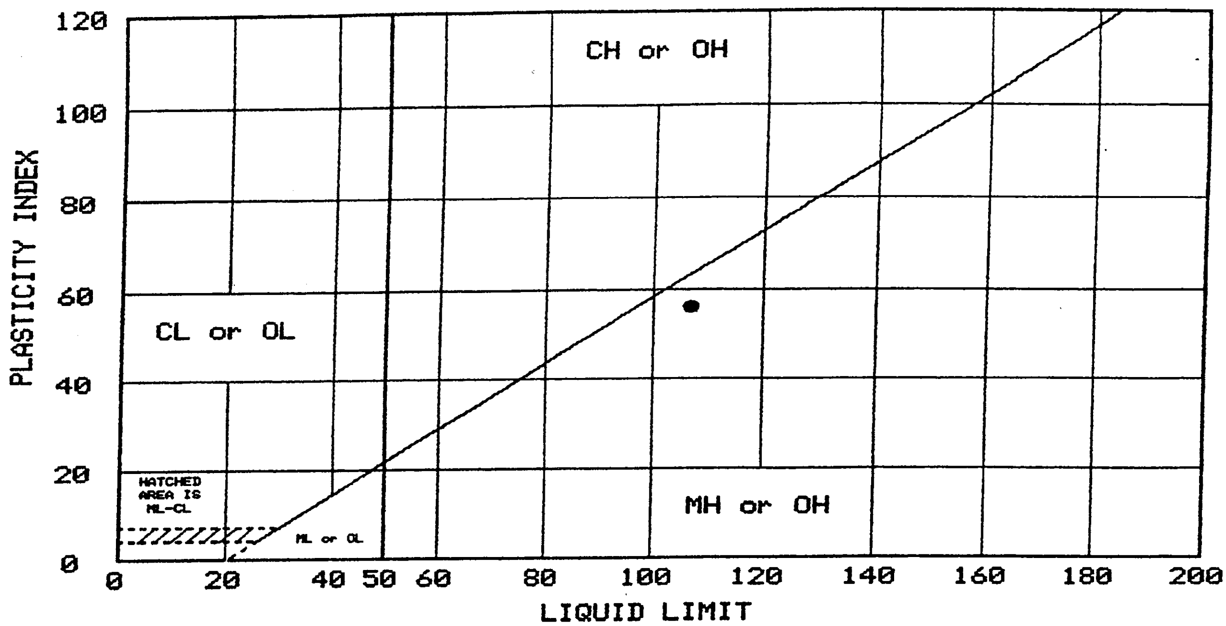
Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

SUELOS INC.

Figure No.______

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	CLAYEY SILT, SAND TRACES, YELLOWISH RED	107	51	56		MH	

Project No.:
Project: MARTIN PENA CHANNEL

Client:
Location: SAN JUAN P.R.

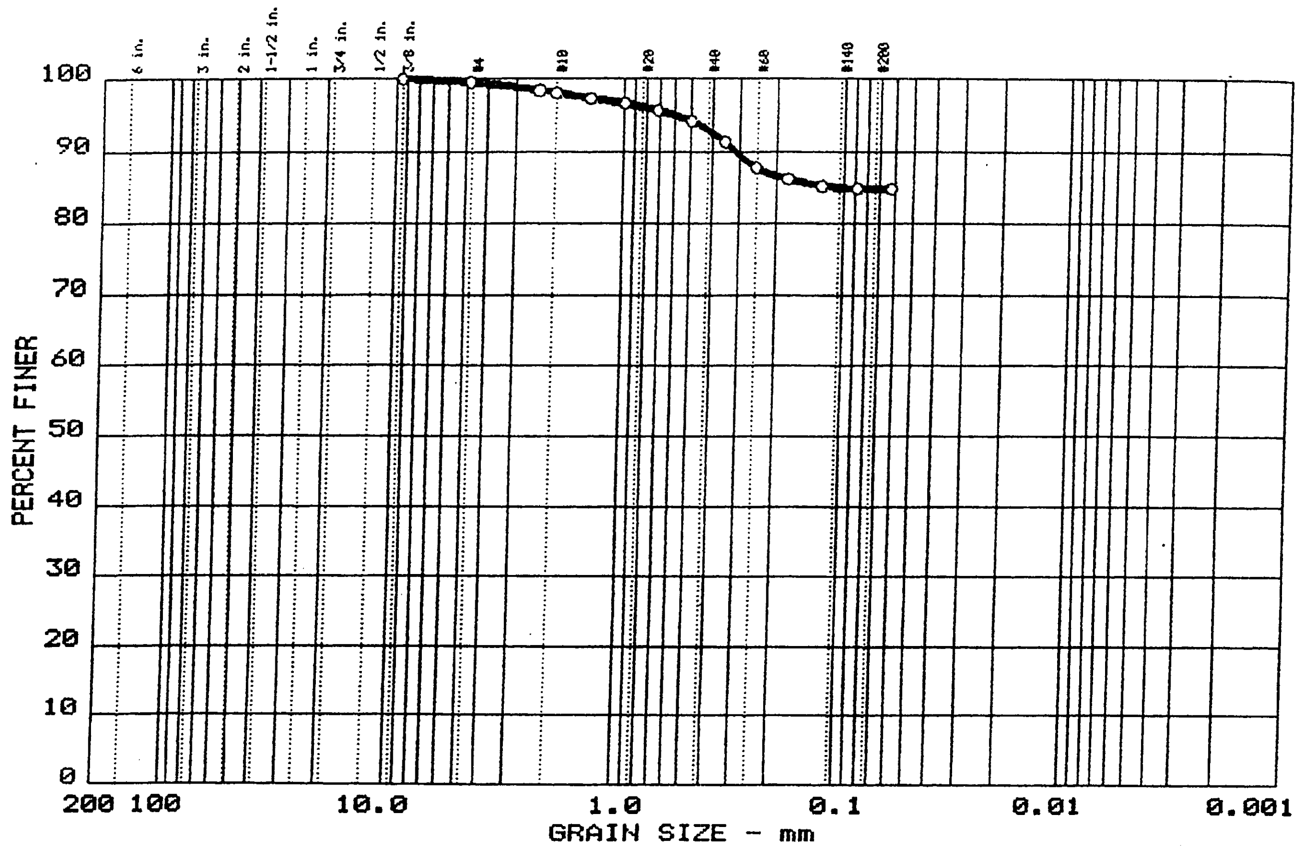
Date: 04-29-97

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MPUC-L2
SAMPLE NO. 28
DEPTH 40.5-42.0'

Fig. No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.5	14.7	84.8	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.10							

MATERIAL DESCRIPTION	USCS	AASHTO
○ CLAYEY SILT, LITTLE SAND, YELL. BROWN AND BROWN	ML	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: CB-MPUC-L2, SAMPLE 37, DEPTH 54-55.5'

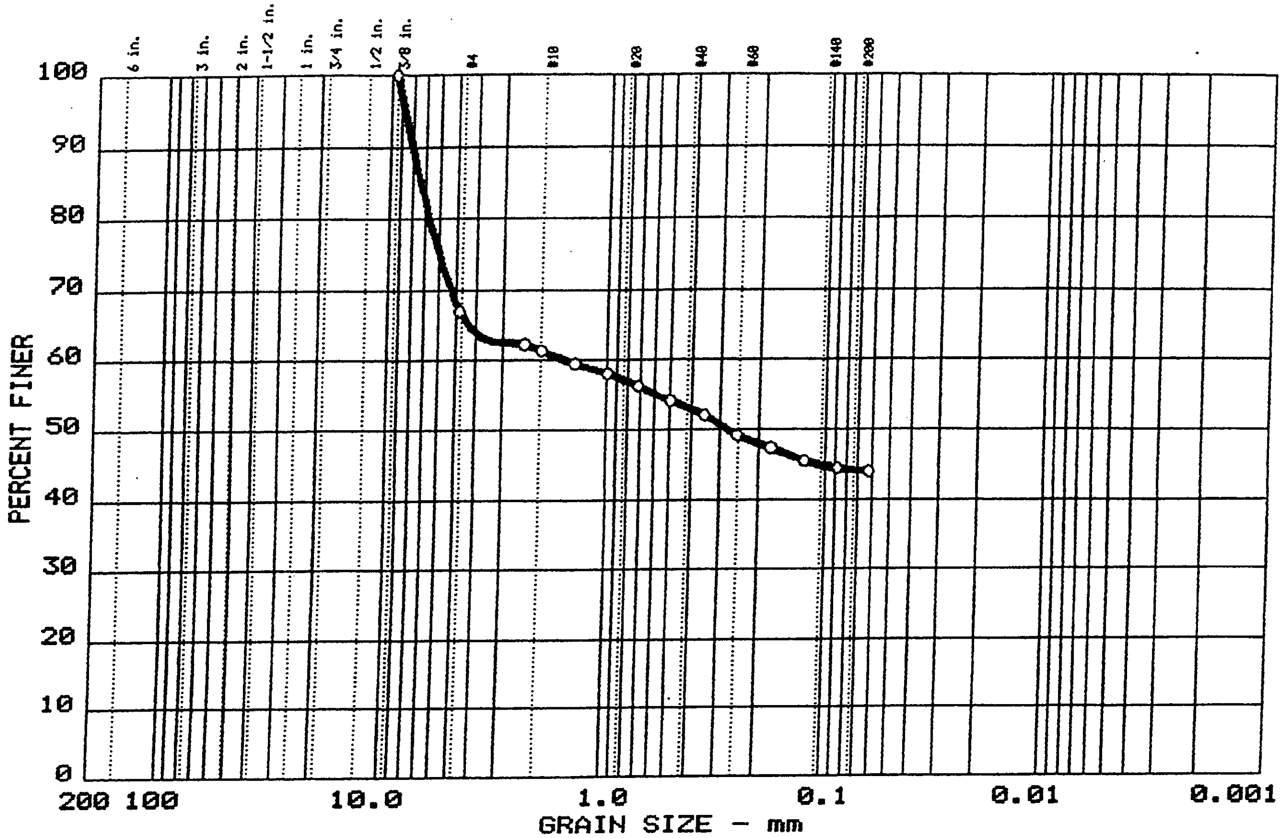
Date: 05-01-97

Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.____

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	33.0	22.8	44.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			7.32	1.55	0.27					

MATERIAL DESCRIPTION	USCS	AASHTO
○ SILT, SOME GRAVEL, LITTLE SAND, YELLOWISH BROWN	GM	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN P.R.

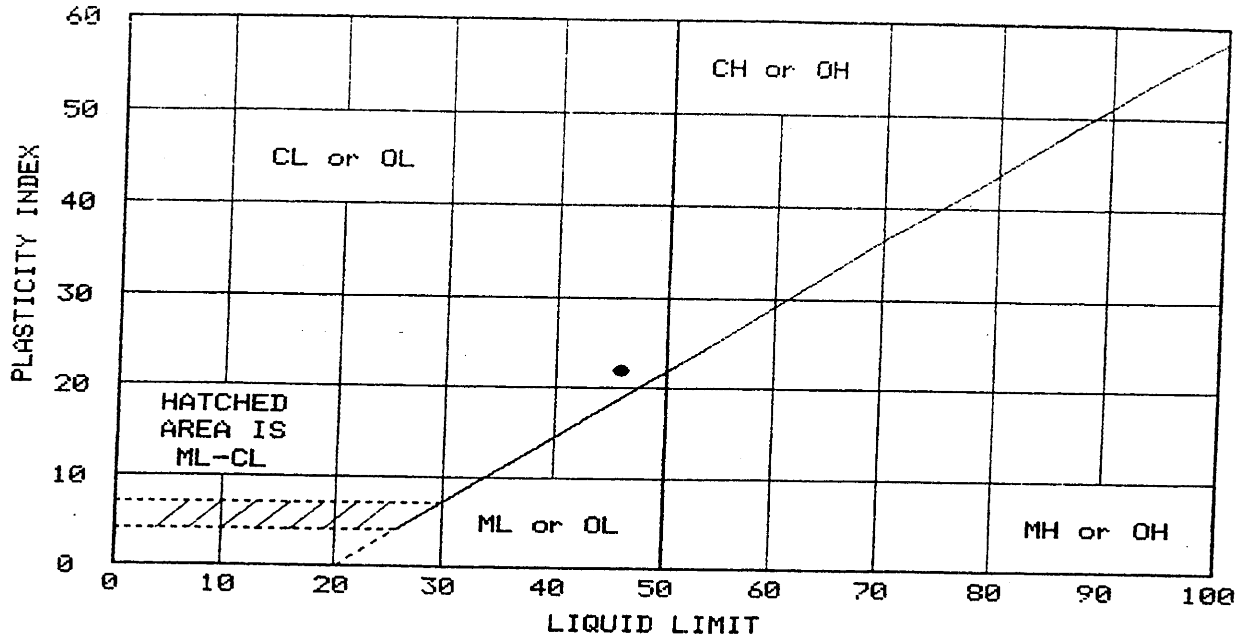
Date: 05-02-97

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MPUC-L3
SAMPLE NO. 3
DEPTH: 3.0-4.5'

Figure No.______

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	USCS	AASHTO
● SILT, SOME GRAVEL, LITTLE SAND, YELLOWISH BROWN	46	24	22		OL	

Project No.:
Project: MARTIN PENA CHANNEL

Client:
Location: SAN JUAN P.R.

Date: 05-09-97

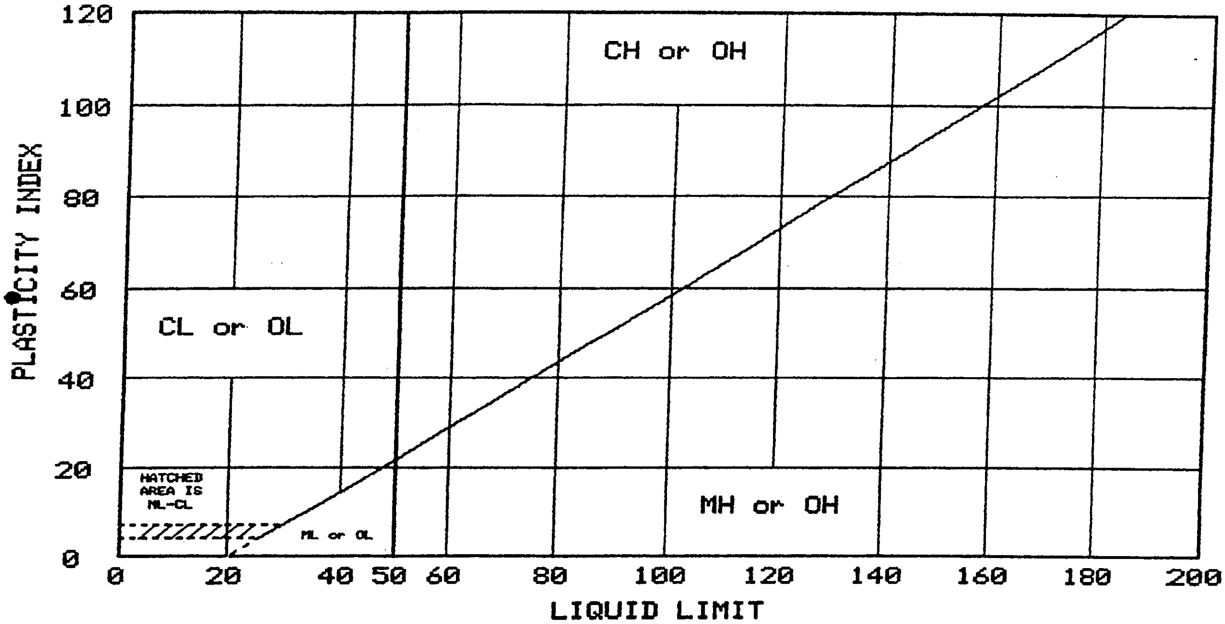
LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:

BOR.CB-MPUC-L3
SAMPLE 3
DEPTH 3.0' TO 4.5'

Fig. No.______

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	PEAT, VERY DARK GRAY AND BLACK	241	183	58		PT	

Project No.:
Project: MARTIN PENA CHANNEL

Client:
Location: SAN JUAN P.R.

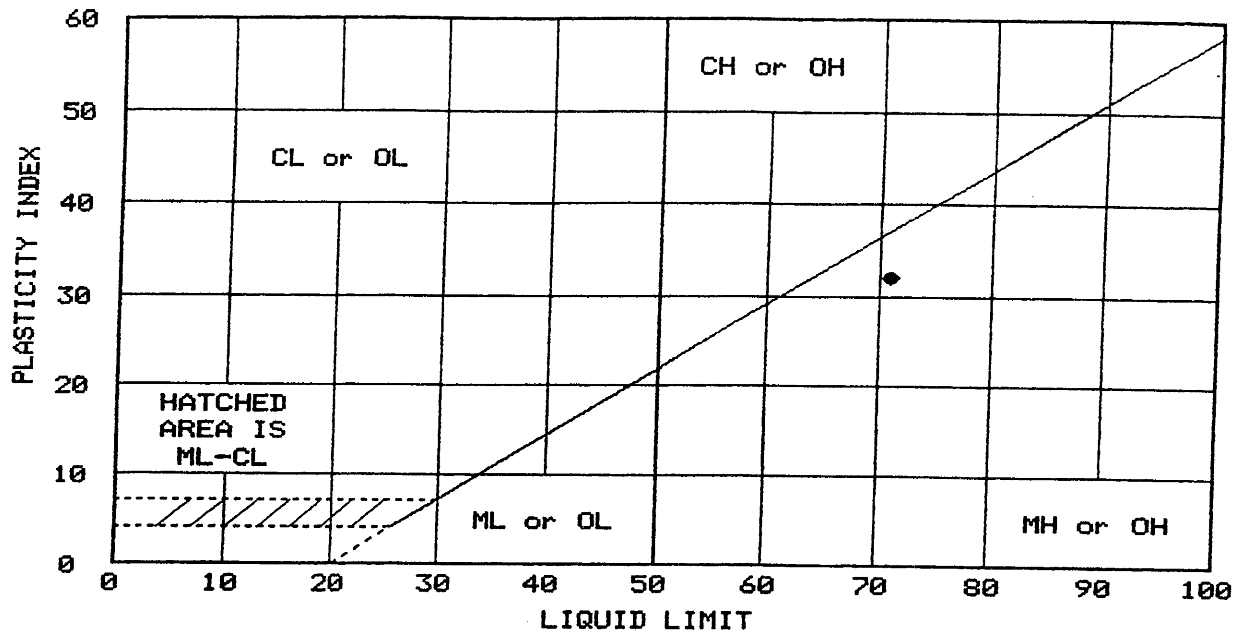
Date: 04-30-97

Remarks:
BOR. CB-MPUC-L3
SAMPLE NO. 6
DEPTH 7.5-9.0'

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Fig. No.

LIQUID AND PLASTIC LIMITS TEST REPORT



Location + Description	LL	PL	PI	-200	USCS	AASHTO
● SILT, LITTLE SAND, GRAY AND BROWN	71	39	32		MH	

Project No.:
Project: MARTIN PENA CHANNEL

Client:
Location: SAN JUAN P.R.

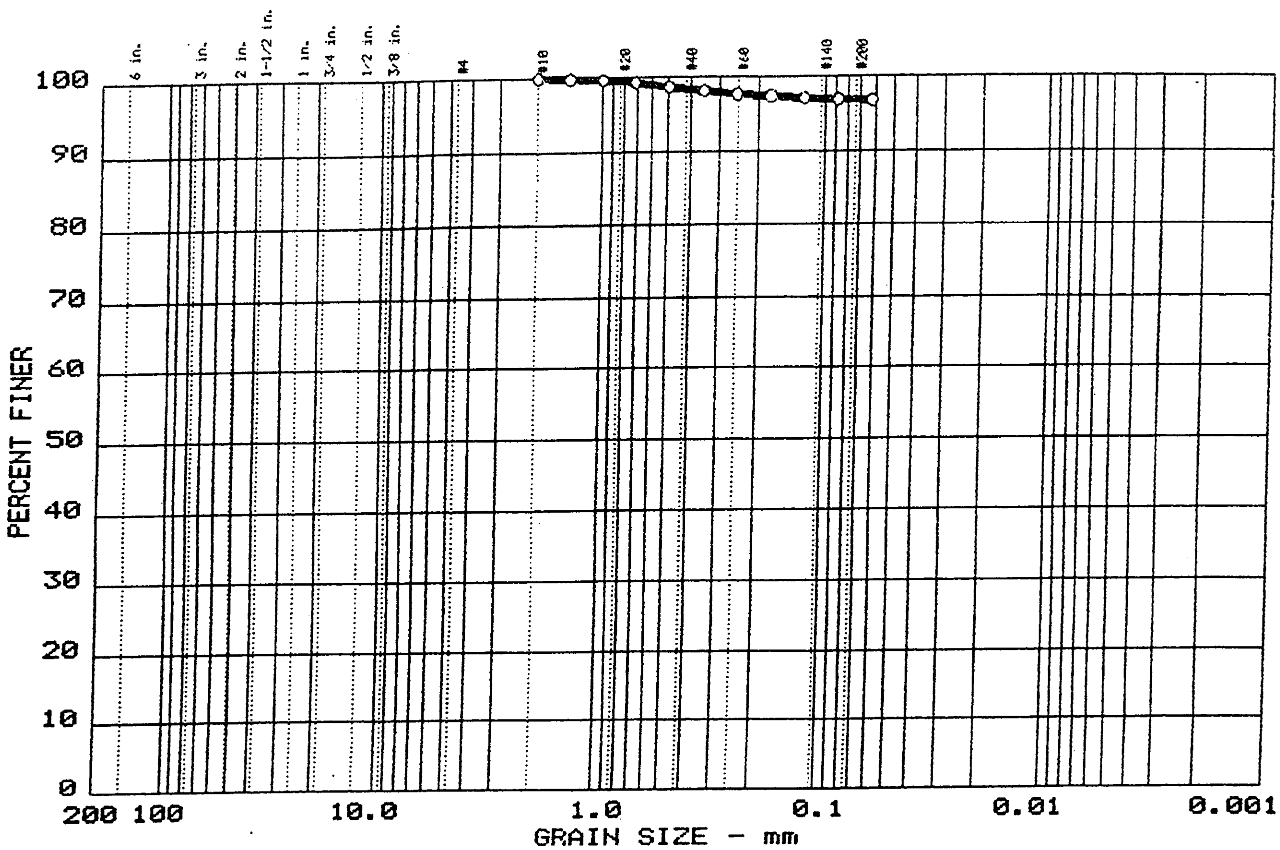
Date: 04-30-97

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MPUC-L3
SAMPLE NO. 15
DEPTH 21.0-22.5'

Fig. No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	3.1	96.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

MATERIAL DESCRIPTION	USCS	AASHTO
○ CLAY, SAND TRACES, YELLOWISH BROWN	CL	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN PR.

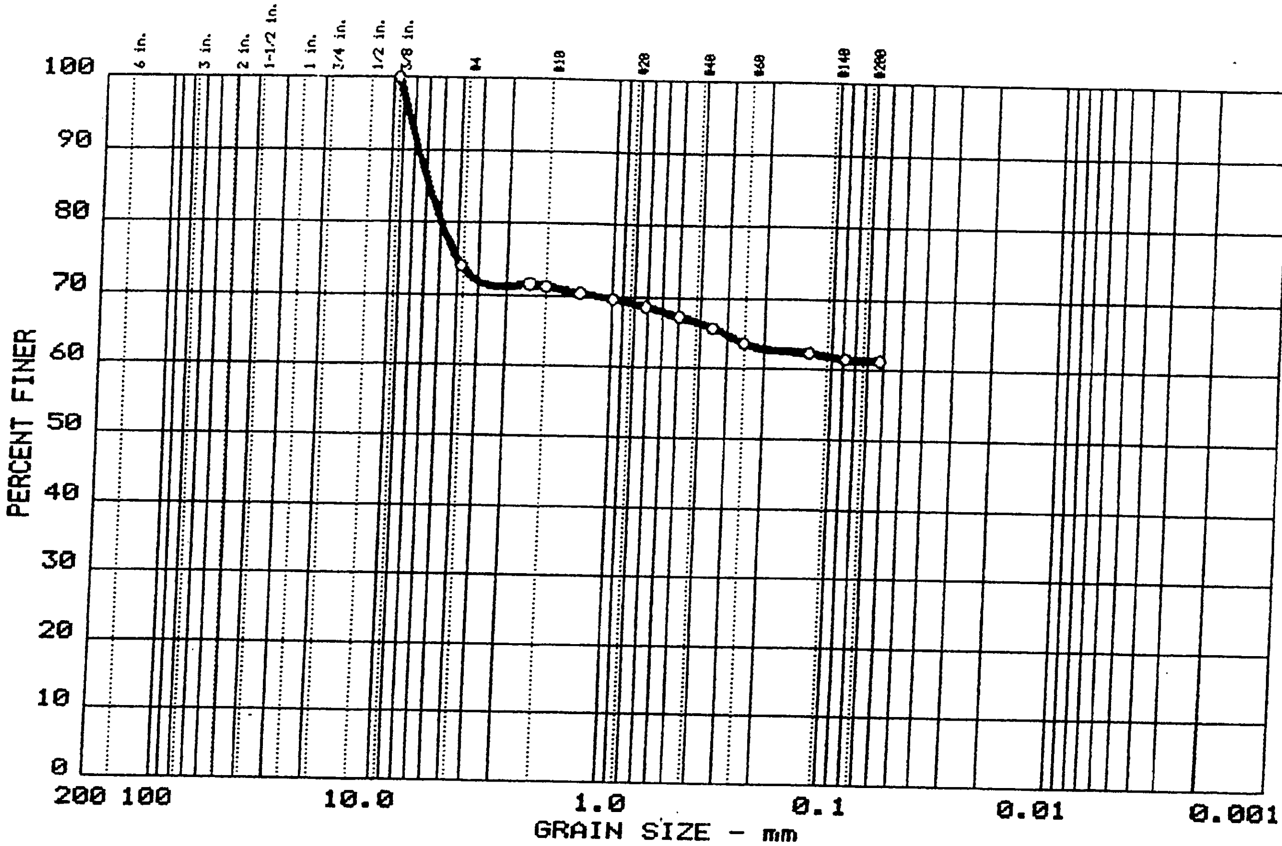
Date: 05-02-97

Remarks:
BOR.CB-MPUC-L3
SAMPLE: 26
DEPTH 37.5' TO 39.0'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	26.0	12.7	61.3	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			6.79							

MATERIAL DESCRIPTION	USCS	AASHTO
○ CLAY, SOME LIMESTONE FGTS., TRACE SAND, YELL. BRN	CL	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN P.R.

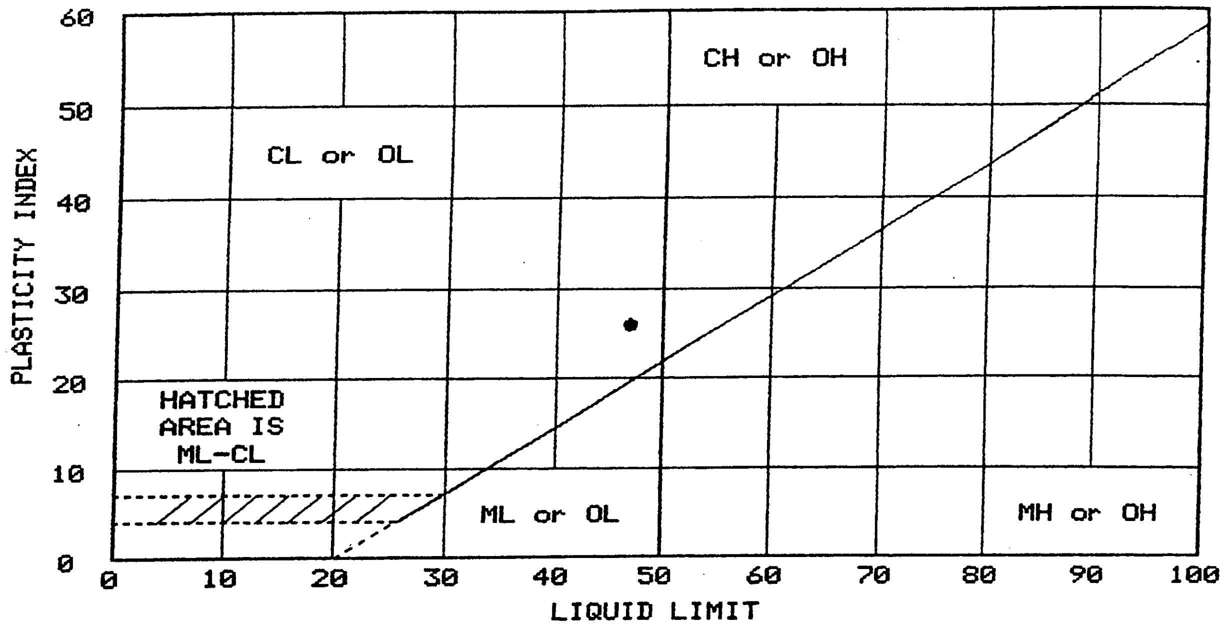
Date: 05-02-97

Remarks:
BOR. CB-MPUC-L3
SAMPLE NO. 31
DEPTH 45.0-46.5'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	CLAY, SOME LIMESTONE FGTS. TRACE SAND, YELLOWISH BROWN	47	21	26		CL	

Project No.:
Project: MARTIN PENA CHANNEL

Client:
Location: SAN JUAN P.R.

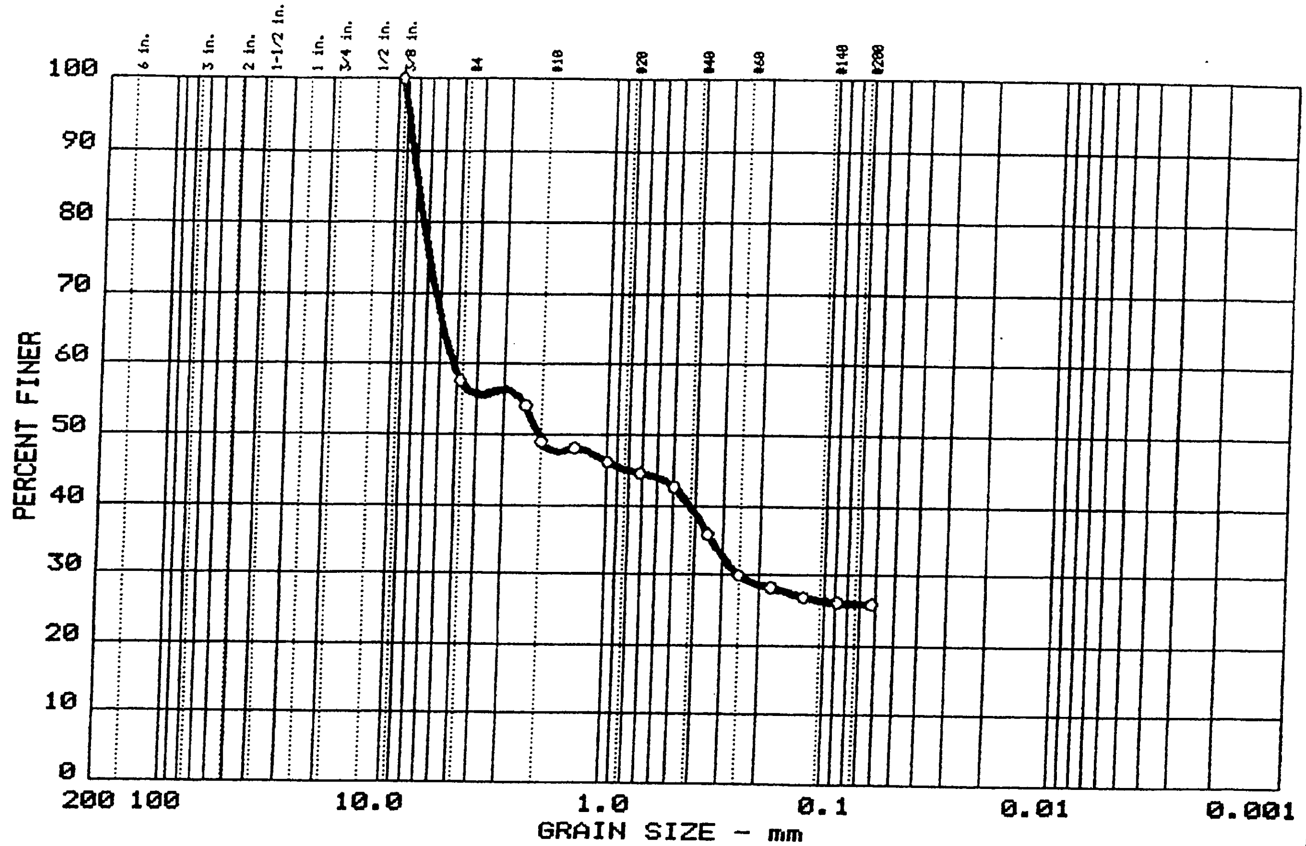
Date: 05-02-97

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MPUC-L3
SAMPLE NO. 31
DEPTH 45.0-46.5'

Fig. No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	42.3	31.7	26.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			7.85	5.13	2.07	0.251				

MATERIAL DESCRIPTION	USCS	AASHTO
○ LIMESTONE FGTS.,SILTY,SANDY,PALE YELLOW	GM	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN P.R.

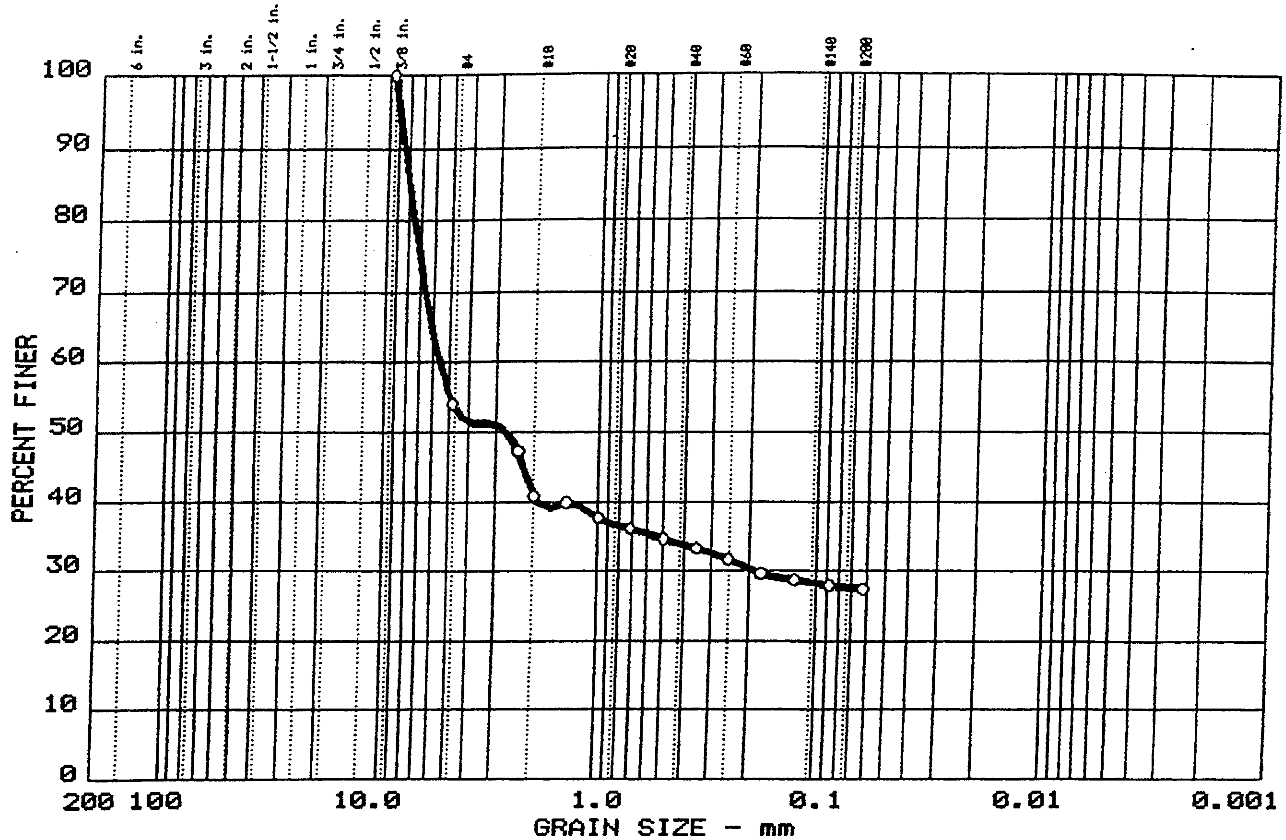
Date: 05-02-97

Remarks:
BOR. CB-MPUC-L3
SAMPLE NO. 33
DEPTH 48-49.5'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	45.9	26.5	27.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o			7.97	5.53	2.65	0.190				

MATERIAL DESCRIPTION	USCS	AASHTO
o LIMESTONE FGTS.,SILTY,SANDY,PALE YELLOW	GM	

Project No.:
Project: MARTIN PENA CHANNEL
o Location: SAN JUAN P.R.

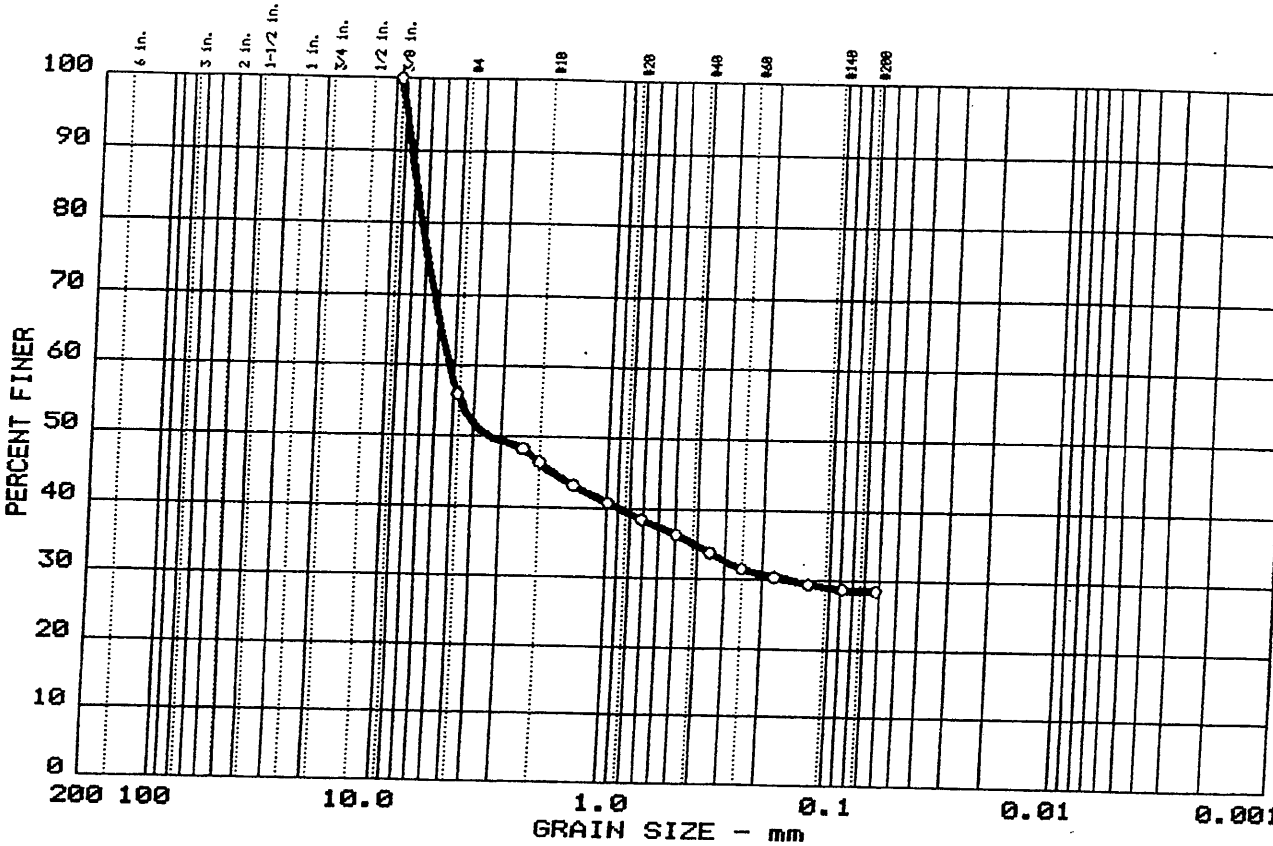
Date: 05-02-97

Remarks:
BOR. CB-MPUC-L3
SAMPLE NO. 35
DEPTH 51.0-52.5'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	43.9	27.5	28.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			7.83	5.23	3.34	0.153				

MATERIAL DESCRIPTION	USCS	AASHTO
○ LIMESTONE FGTS.,SILTY,SANDY,PALE YELLOW	GM	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN P.R.

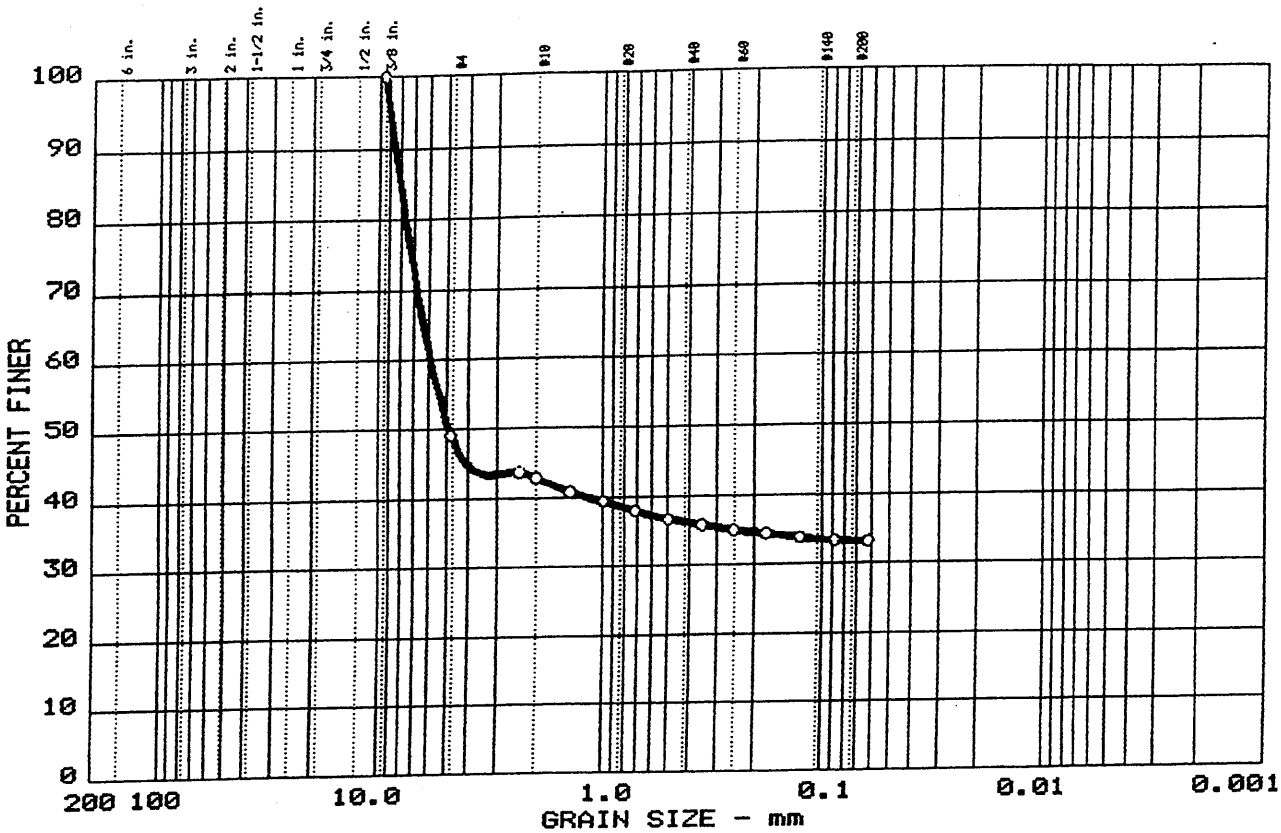
Date: 05-02-97

Remarks:
BOR. CB-MPUC-L3
SAMPLE NO. 38
DEPTH 55.5-57.0'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	50.9	16.0	33.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o			8.06	5.86	4.86					

MATERIAL DESCRIPTION	USCS	AASHTO
o CLAYEY GRAVEL, LITTLE SAND, YELLOWISH BROWN	GC	

Project No.:
Project: MARTIN PENA CHANNEL
o Location: SAN JUAN P.R.

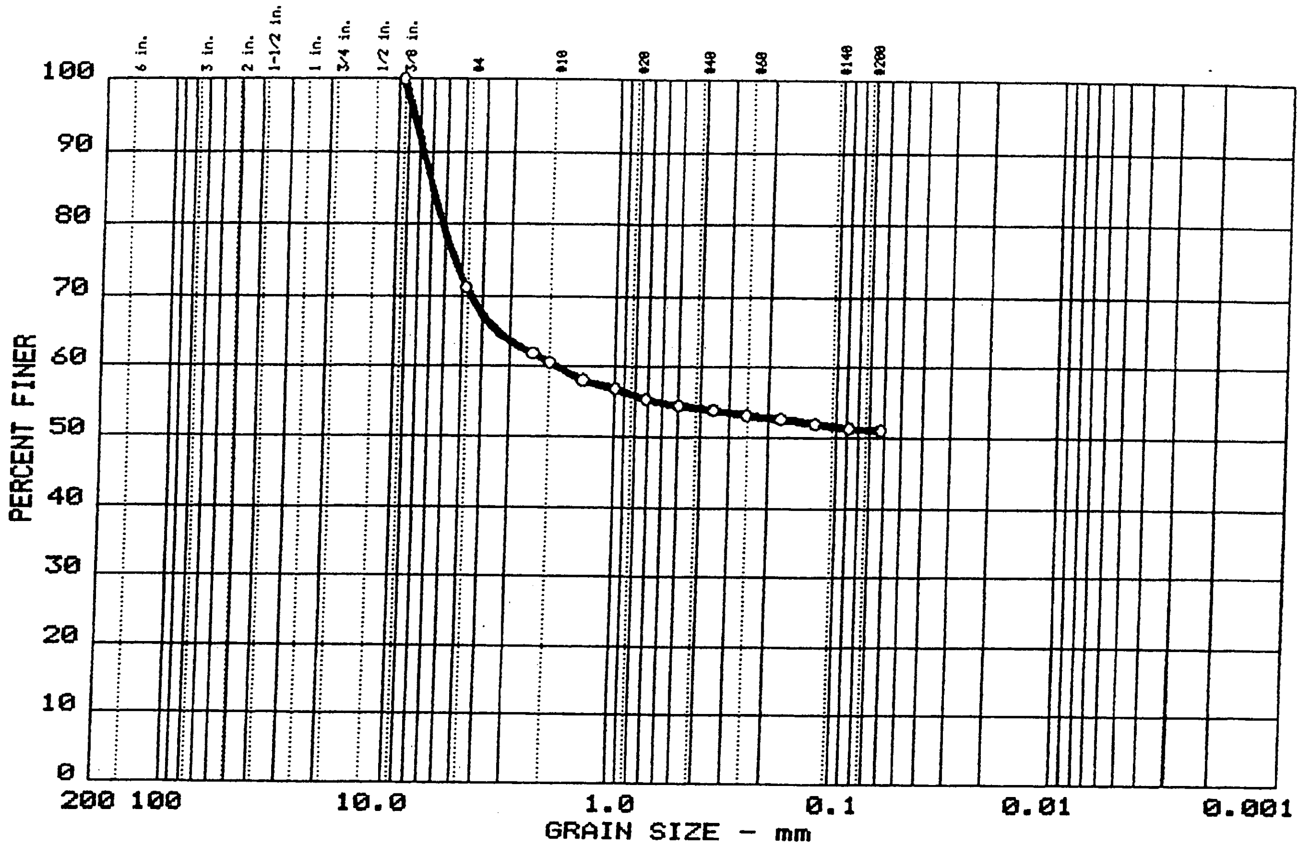
Date: 04-29-97

Remarks:
BOR. CB-MPUC-L4
SAMPLE NO. 2
DEPTH 1.5-3.0'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	28.7	20.1	51.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			6.92	1.84						

MATERIAL DESCRIPTION	USCS	AASHTO
○ CLAY, SOME GRAVEL, SOME SAND, DARK YELL. BROWN	CL	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN P.R.

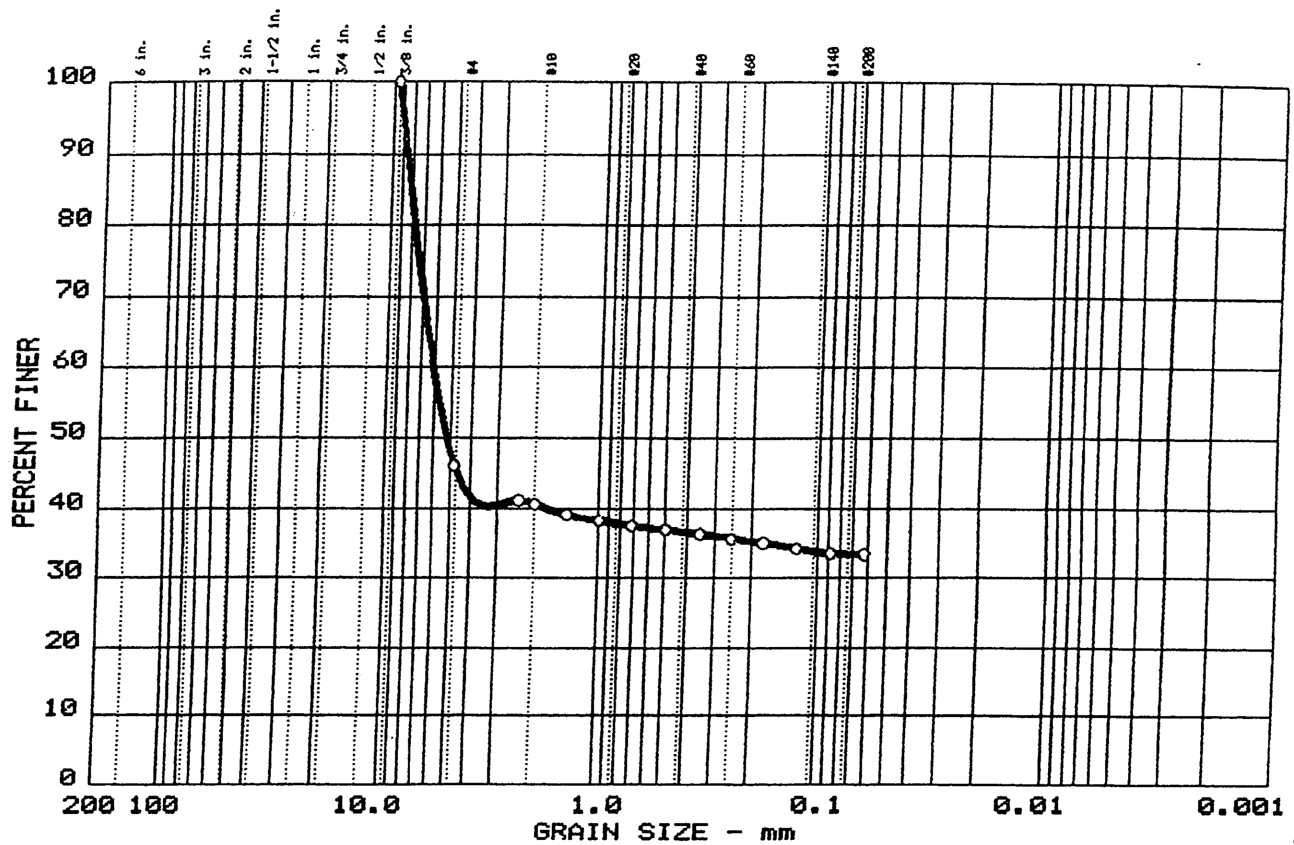
Date: 04-29-97

Remarks:
BOR. CB-MPUC-L4
SAMPLE NO. 5
DEPTH 6.0-7.5'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	53.9	12.8	33.3	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			8.14	6.07	5.16					

MATERIAL DESCRIPTION	USCS	AASHTO
○ SILTY GRAVEL, LITTLE SAND, YELLOWISH BROWN	GM	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN P.R.

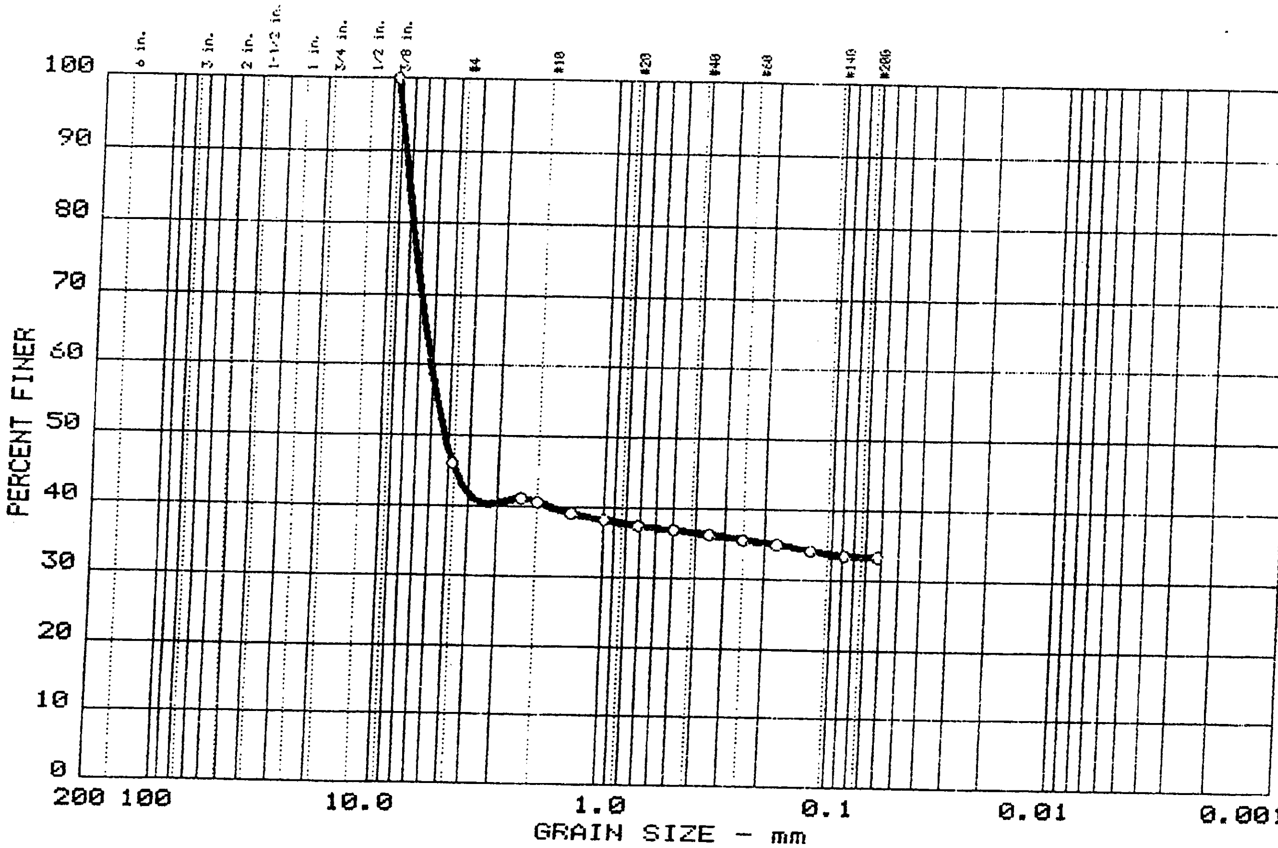
Date: 04-29-97

Remarks:
BOR. CB-MPUC-L4
SAMPLE NO. 10
DEPTH 13.5-15.0'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	53.9	12.8	33.3	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			8.14	6.07	5.16					

MATERIAL DESCRIPTION	USCS	AASHTO
○ SILTY GRAVEL, YELLOWISH BROWN		

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN PR.

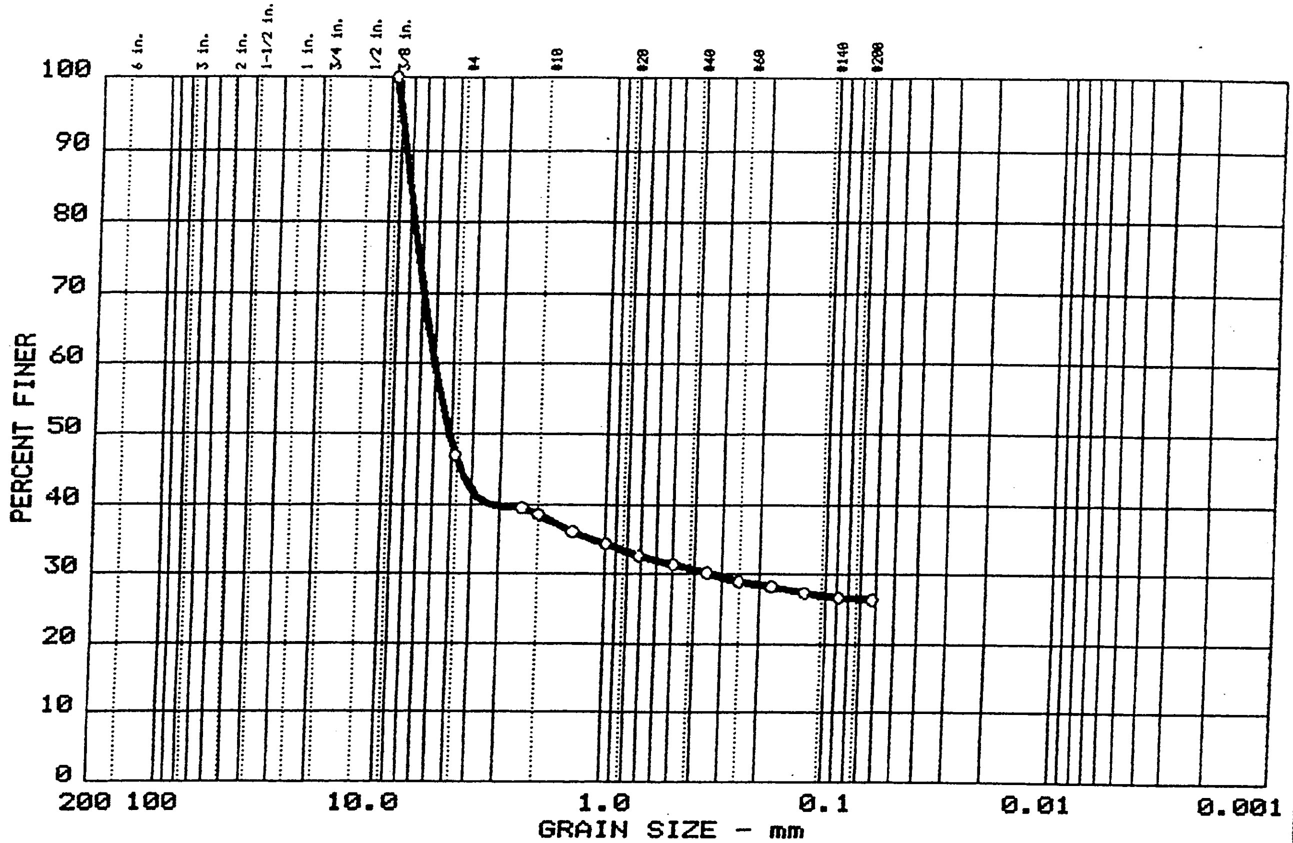
Date: 04-29-97

Remarks:
BOR. CB-MPUC-L4
SAMPLE: 10
DEPTH 13.5' TO 15'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	53.0	20.5	26.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o			8.10	5.98	5.08	0.332				

MATERIAL DESCRIPTION	USCS	AASHTO
o SILTY GRAVEL, SOME SAND, YELLOWISH BROWN	GM	

Project No.:
Project: MARTIN PENA CHANNEL
o Location: SAN JUAN P.R.

Date: 04-29-97

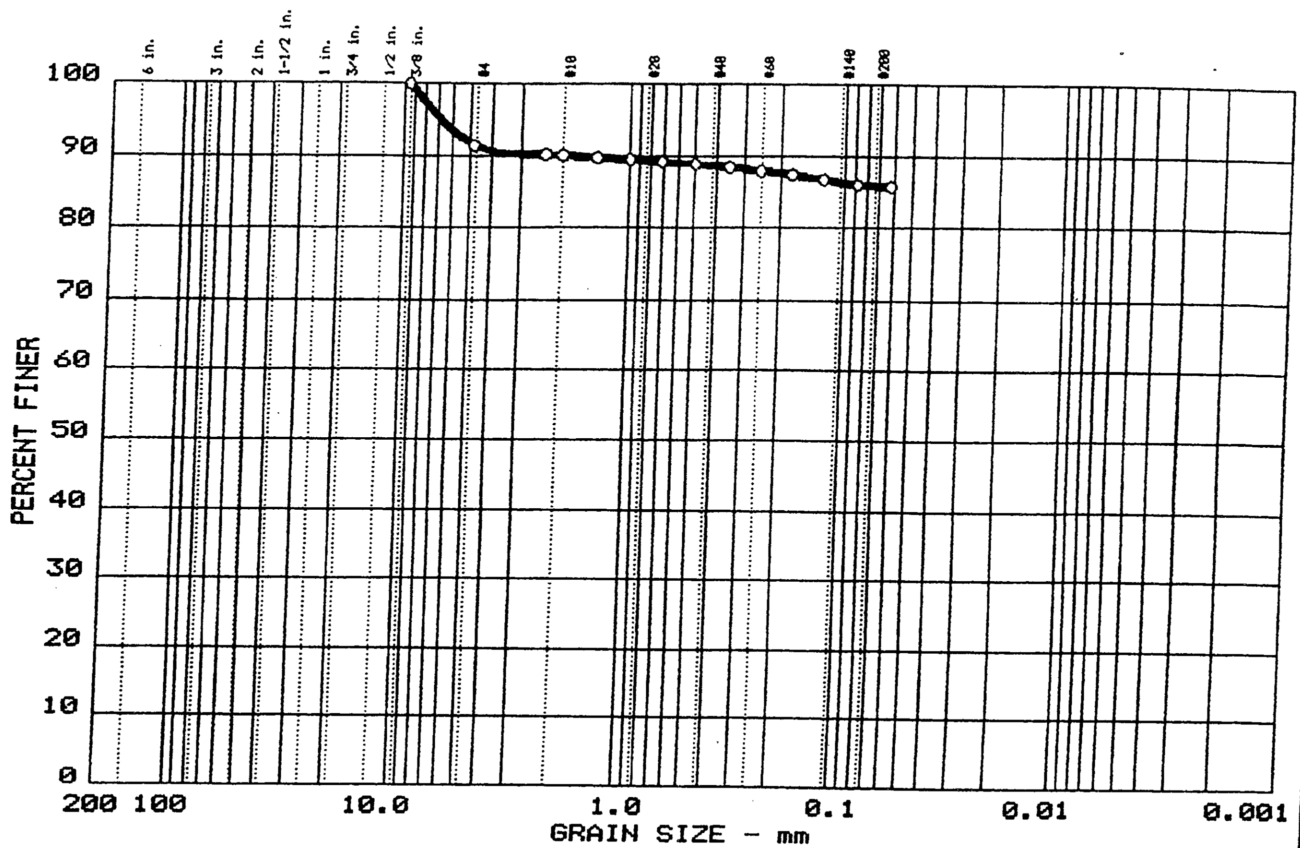
Remarks:
BOR. CB-MPUC-L4
SAMPLE NO. 12
DEPTH: 16.5-18.0'

GRAIN SIZE DISTRIBUTION TEST REPORT

SUELOS INC.

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	8.6	5.7	85.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

MATERIAL DESCRIPTION	USCS	AASHTO
○ SILT,YELLOWISH BROWN	ML	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN P.R.

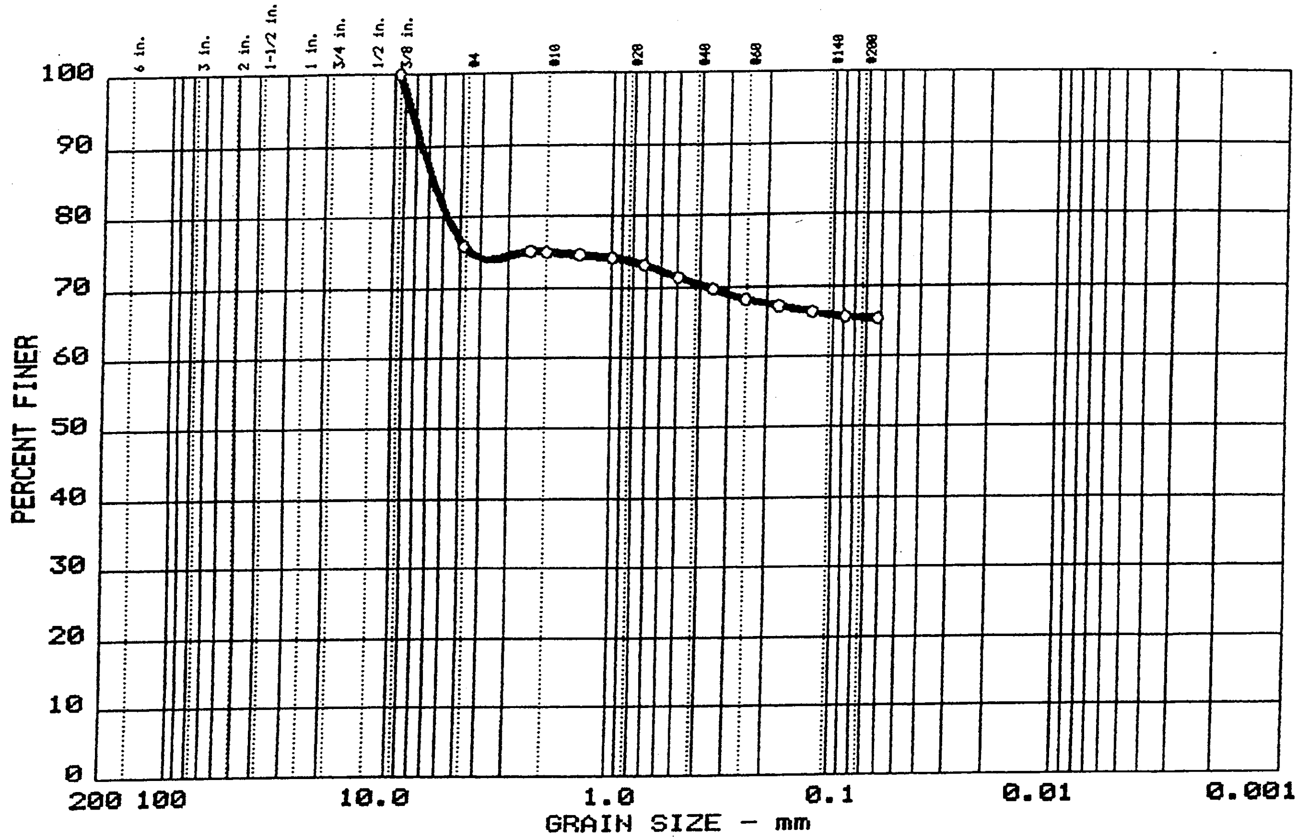
Date: 04-29-97

Remarks:
BOR. CB-MPUC-L4
SAMPLE NO. 14
DEPTH: 19.5-21.0'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	24.2	10.3	65.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			6.65							

MATERIAL DESCRIPTION	USCS	AASHTO
○ SILT, SOME GRAVEL, LITTLE SAND, OLIVE & YELL. BRN.	OH	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN P.R.

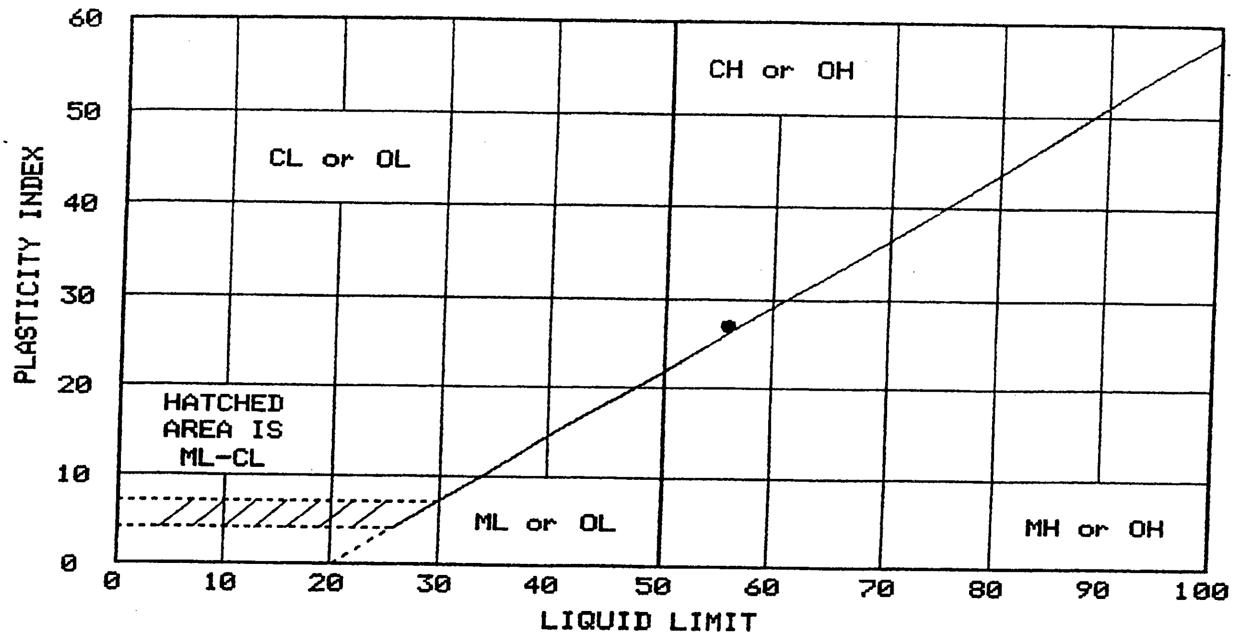
Date: 04-29-97

Remarks:
BOR. CB-MPUC-L4
SAMPLE NO. 18
DEPTH: 25.5-27.0'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	SILT, SOME GRAVEL, LITTLE SAND, OLIVE AND YELLOWISH BROWN	56	29	27		OH	

Project No.:
Project: MARTIN PENA CHANNEL

Client:
Location: SAN JUAN P.R.

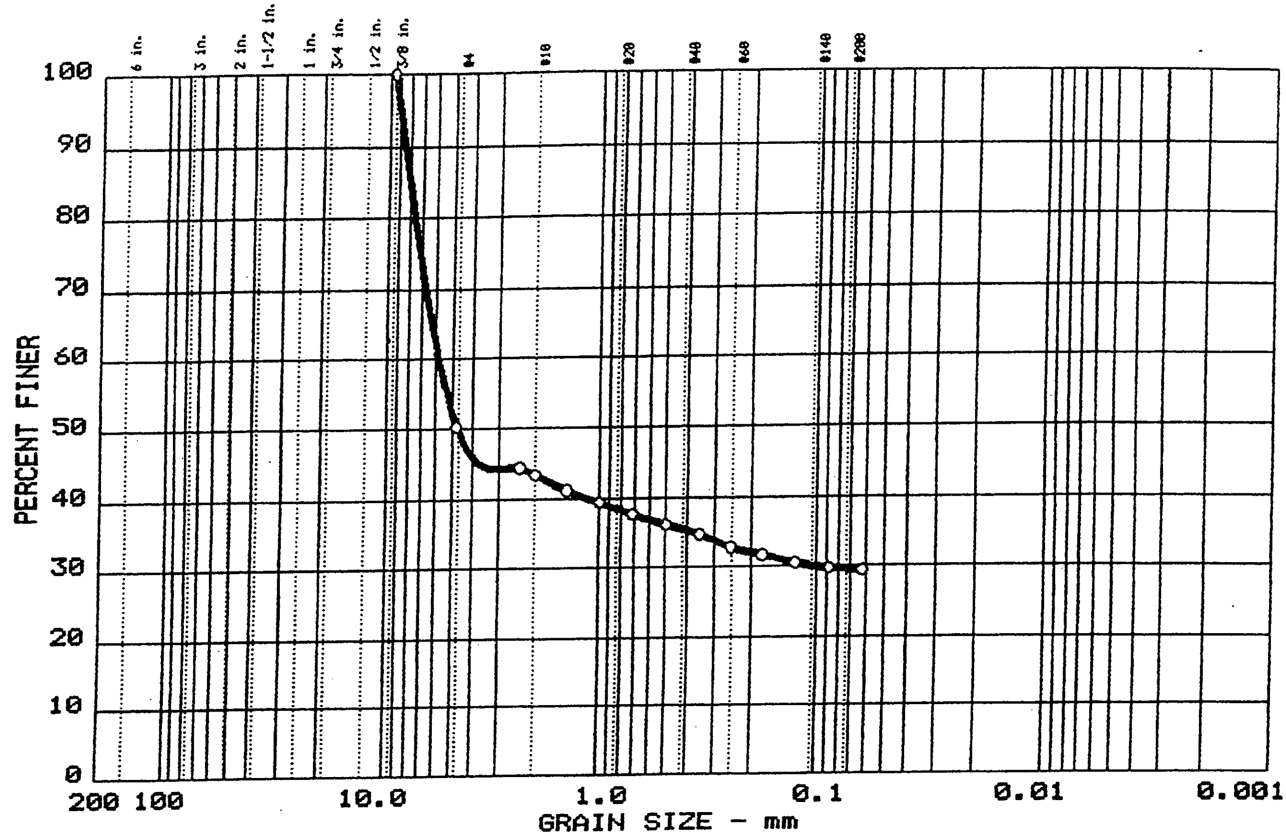
Date: 04-29-97

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MPUC-L4
SAMPLE NO. 18
DEPTH 25.5-27.0'

Fig. No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	49.8	20.8	29.4	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			8.03	5.77	4.73	0.099				

MATERIAL DESCRIPTION	USCS	AASHTO
○ SILTY GRAVEL, SOME SAND, YELLOWISH BROWN	GM	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN P.R.

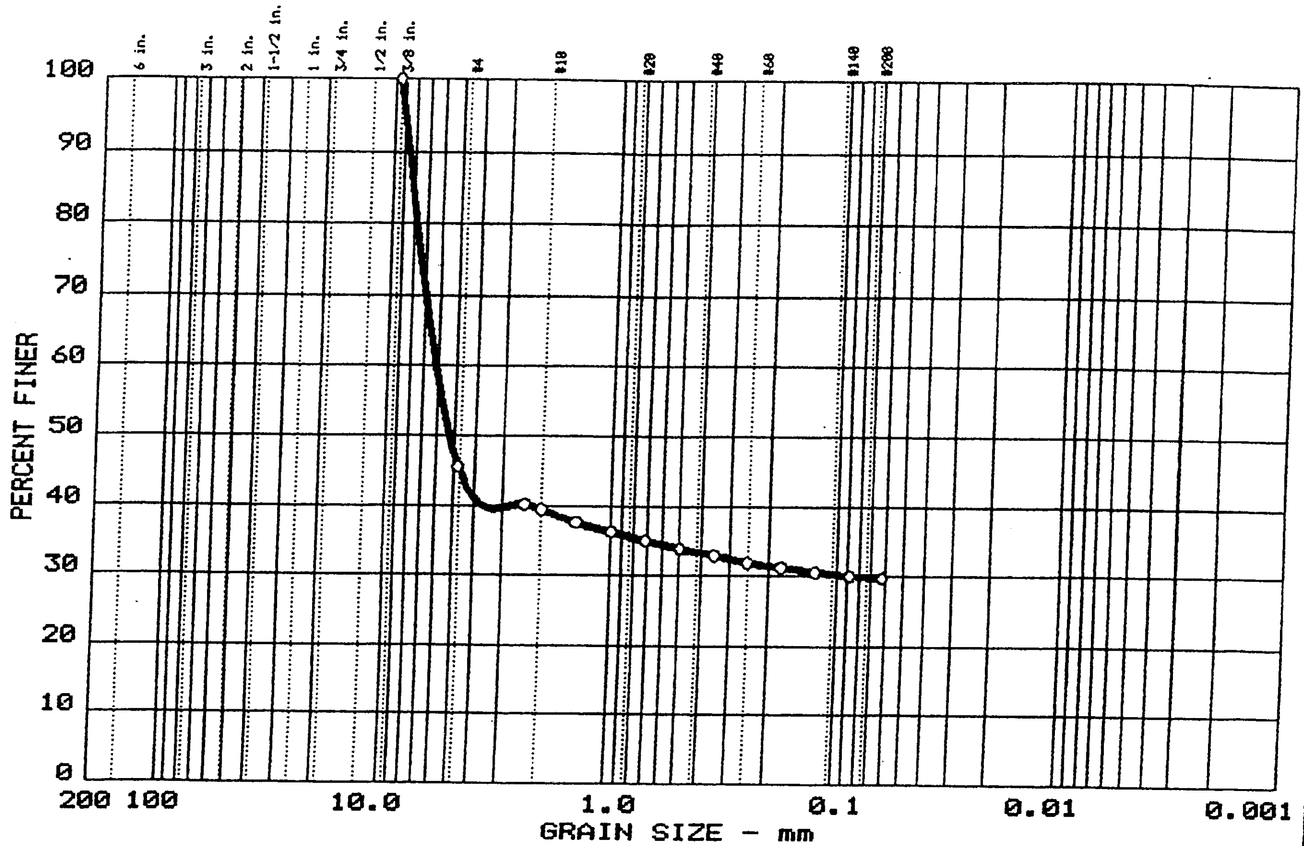
Date: 04-29-97

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:
BOR. CB-MPUC-L4
SAMPLE NO. 21
DEPTH 30.0-31.5'

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	54.5	15.7	29.8	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			8.16	6.10	5.23	0.090				

MATERIAL DESCRIPTION	USCS	AASHTO
○ SILTY GRAVEL, LITTLE SAND, YELLOWISH BROWN	GM	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN P.R.

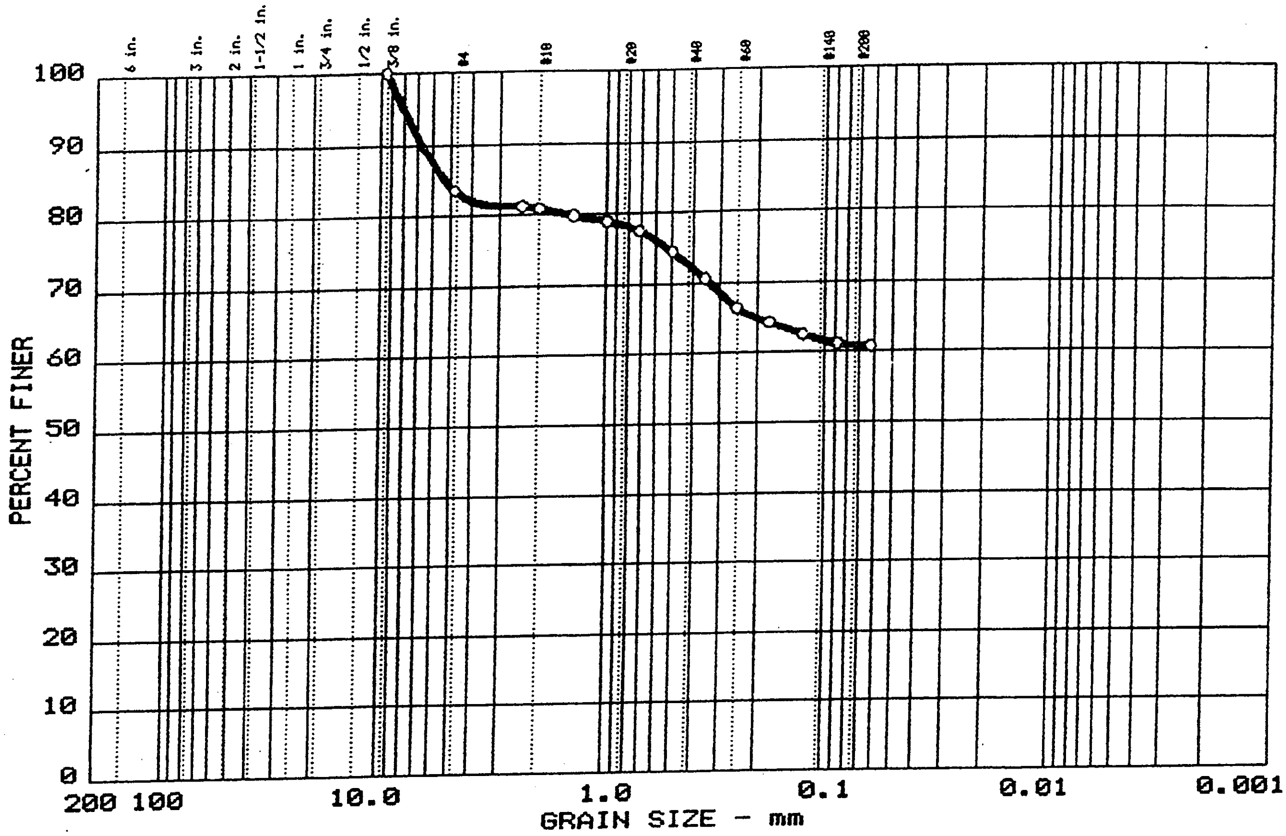
Date: 04-29-97

Remarks:
BOR. CB-MPUC-L4
SAMPLE NO. 25
DEPTH 36.0-37.5'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	16.5	22.6	60.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o			5.25							

MATERIAL DESCRIPTION	USCS	AASHTO
o SILT,SOME SAND,LITTLE GRAVEL,LIGHT OLIVE BROWN	ML	

Project No.:
Project: MARTIN PENA CHANNEL
o Location: SAN JUAN P.R.

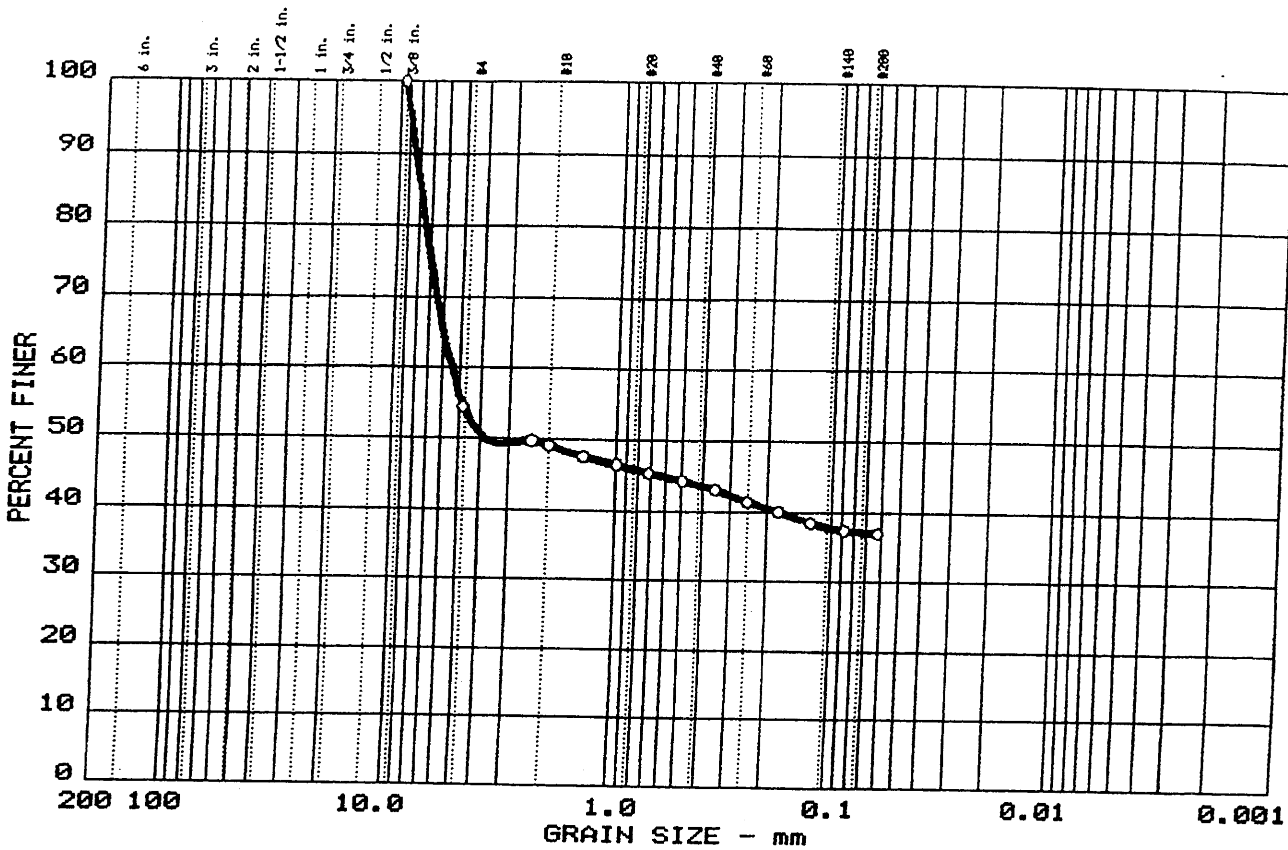
Date: 04-29-97

Remarks:
BOR. CB-MPUC-L4
SAMPLE NO. 31
DEPTH 45.0-46.5'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	45.5	17.4	37.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			7.90	5.42	3.75					

MATERIAL DESCRIPTION	USCS	AASHTO
○ SILTY GRAVEL,LITTLE SAND,LIGHT OLIVE BROWN	GM	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN P.R.

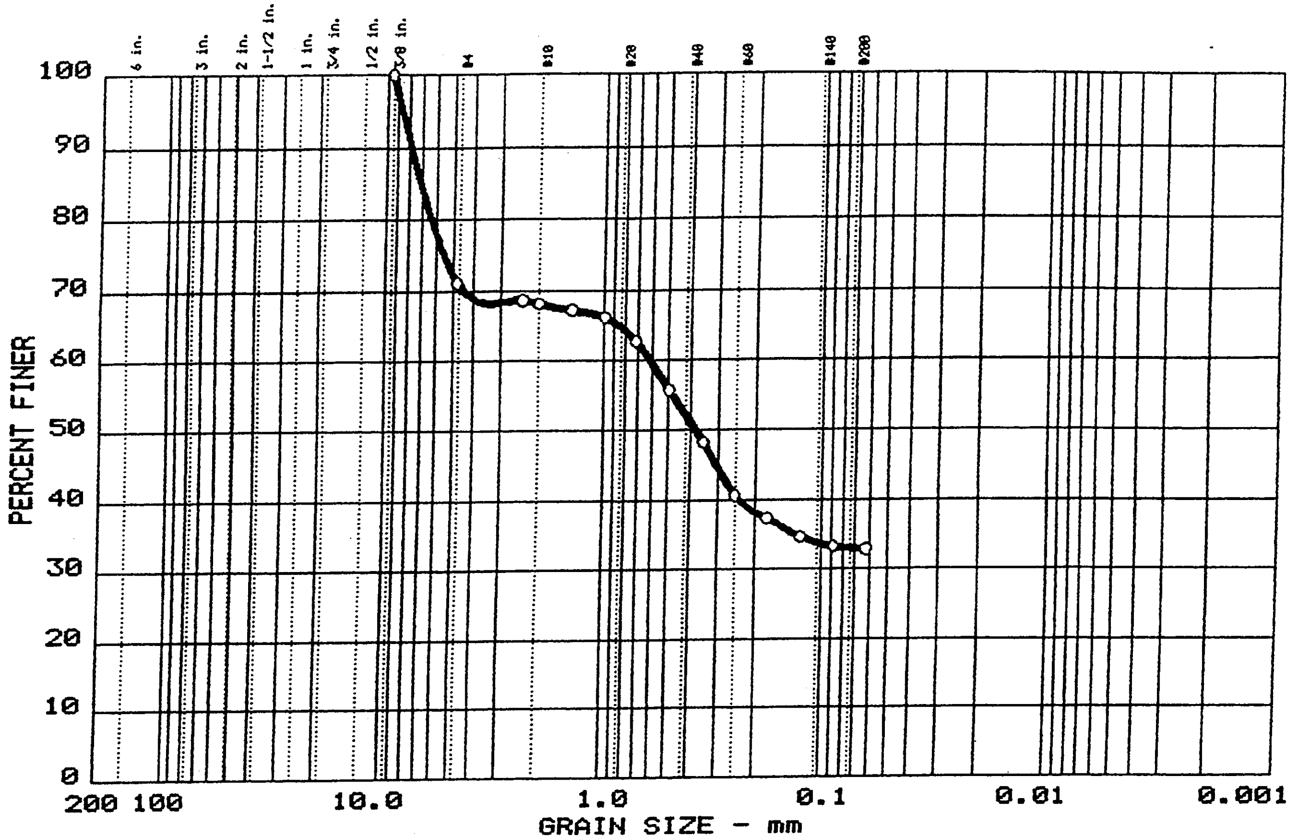
Date: 04-29-97

Remarks:
BOR. CB-MPUC-L4
SAMPLE NO. 37
DEPTH 54.0-55.5'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	28.9	38.2	32.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			7.06	0.61	0.38					

MATERIAL DESCRIPTION	USCS	AASHTO
○ SILTY SAND, SOME GRAVEL, YELLOWISH BROWN	SM	

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN P.R.

Date: 04-30-97

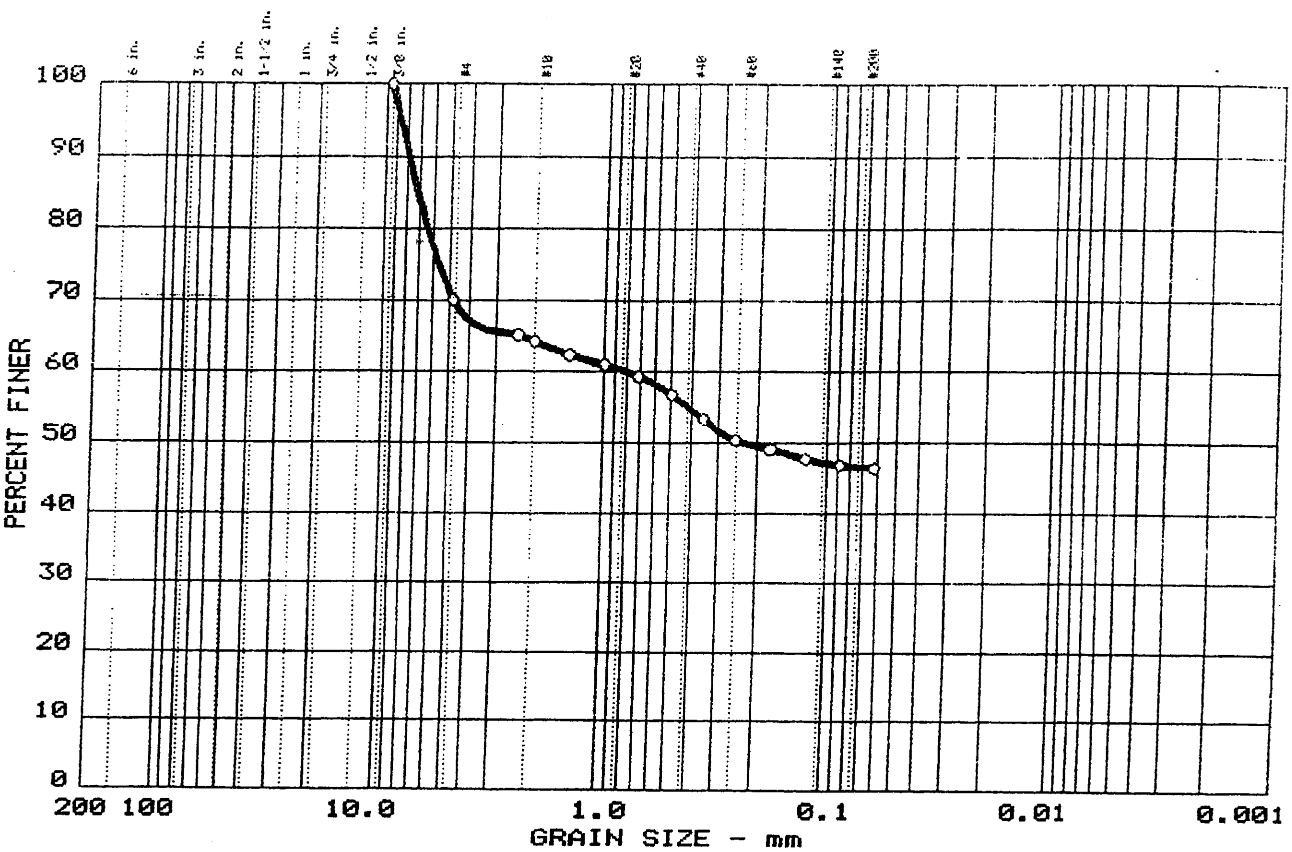
Remarks:
BOR. CB-MPUC-L5
SAMPLE NO. 2
DEPTH 1.5-3.0'

GRAIN SIZE DISTRIBUTION TEST REPORT

SUELOS INC.

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	30.0	23.4	46.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			7.10	0.79	0.22					

MATERIAL DESCRIPTION	USCS	AASHTO
○ SILTY SAND, YELLOWISH BROWN		

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN PR.

Date: 04-30-97

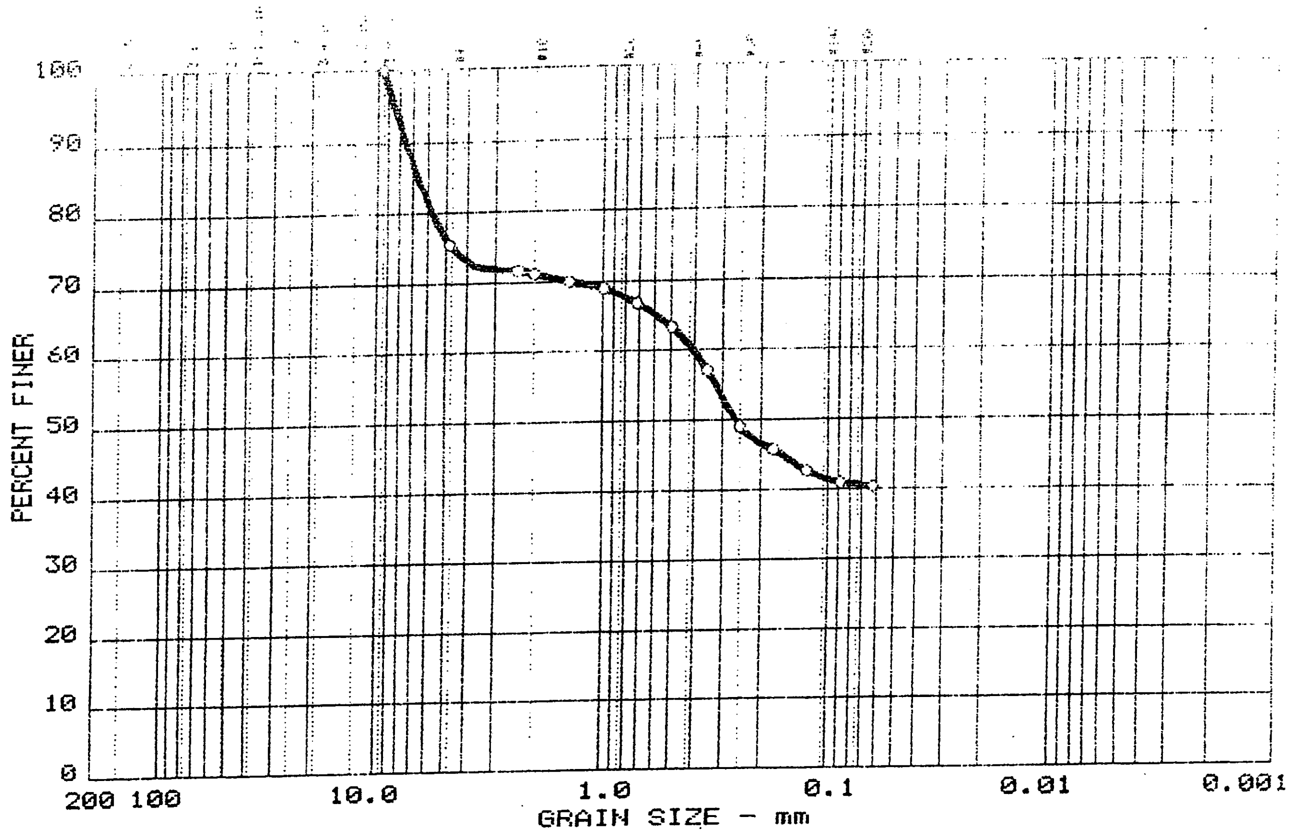
GRAIN SIZE DISTRIBUTION TEST REPORT

SUELOS INC.

Remarks:
BOR.CB-MPUC-L5
SAMPLE: 6
DEPTH 7.5 TO 9'

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	24.6	34.9	40.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			6.61	0.40	0.26					

MATERIAL DESCRIPTION	USCS	AASHTO
○ SILTY SAND, YELLOWISH BROWN		

Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN PR.

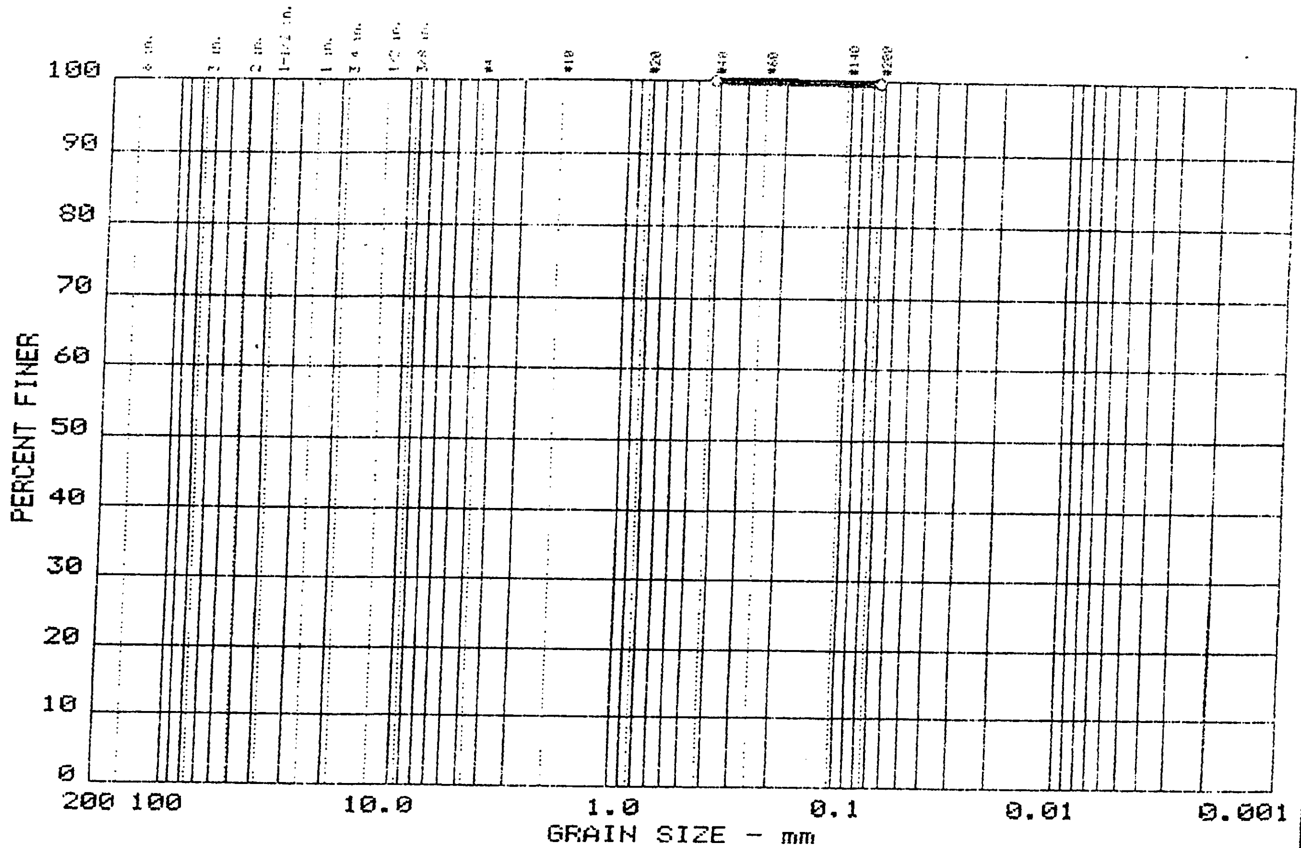
Date: 04-30-97

Remarks:
BOR.CB-MPUC-L5
SAMPLE: 14
DEPTH 19.5' TO 21'

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	0.3	99.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

MATERIAL DESCRIPTION	USCS	AASHTO
○ ORGANIC SILT, VERY DARK GRAY		

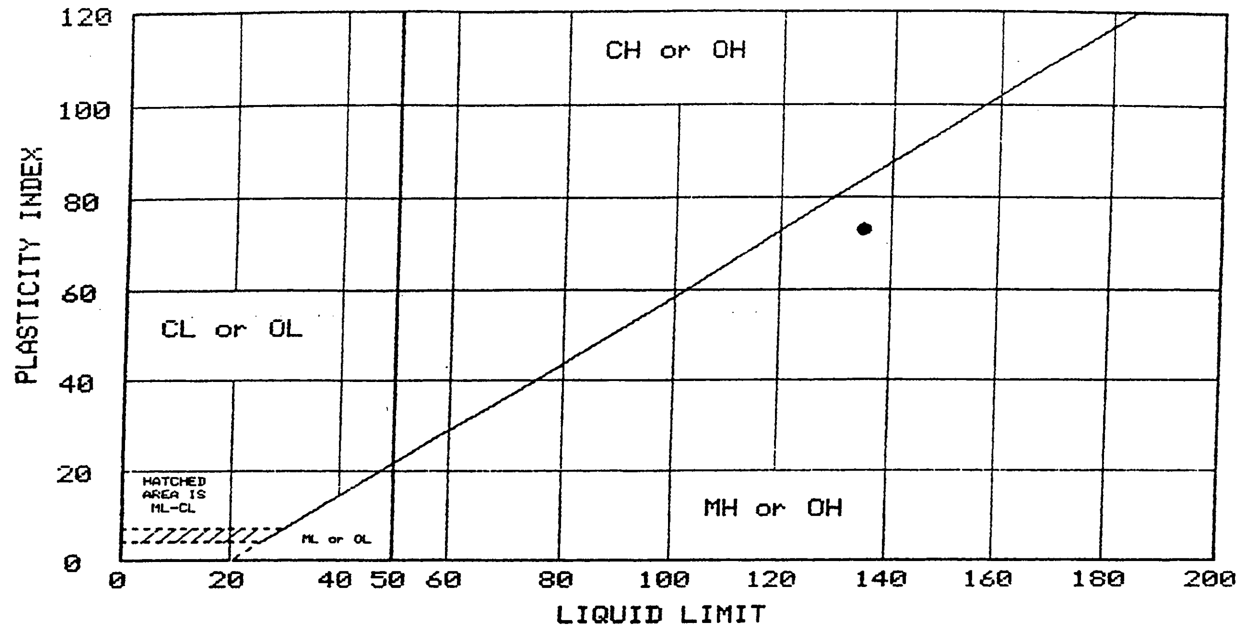
Project No.:
Project: MARTIN PENA CHANNEL
○ Location: SAN JUAN PR.

Date: 05-06-97

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Remarks:
BOR. ES-MPUC-1

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	ORGANIC SILT, VERY DARK GRAY	135	62	73		OH	

Project No.:
Project: MARTIN PENA CHANNEL

Client: ROY F. WESTON
Location: SAN JUAN P.R.

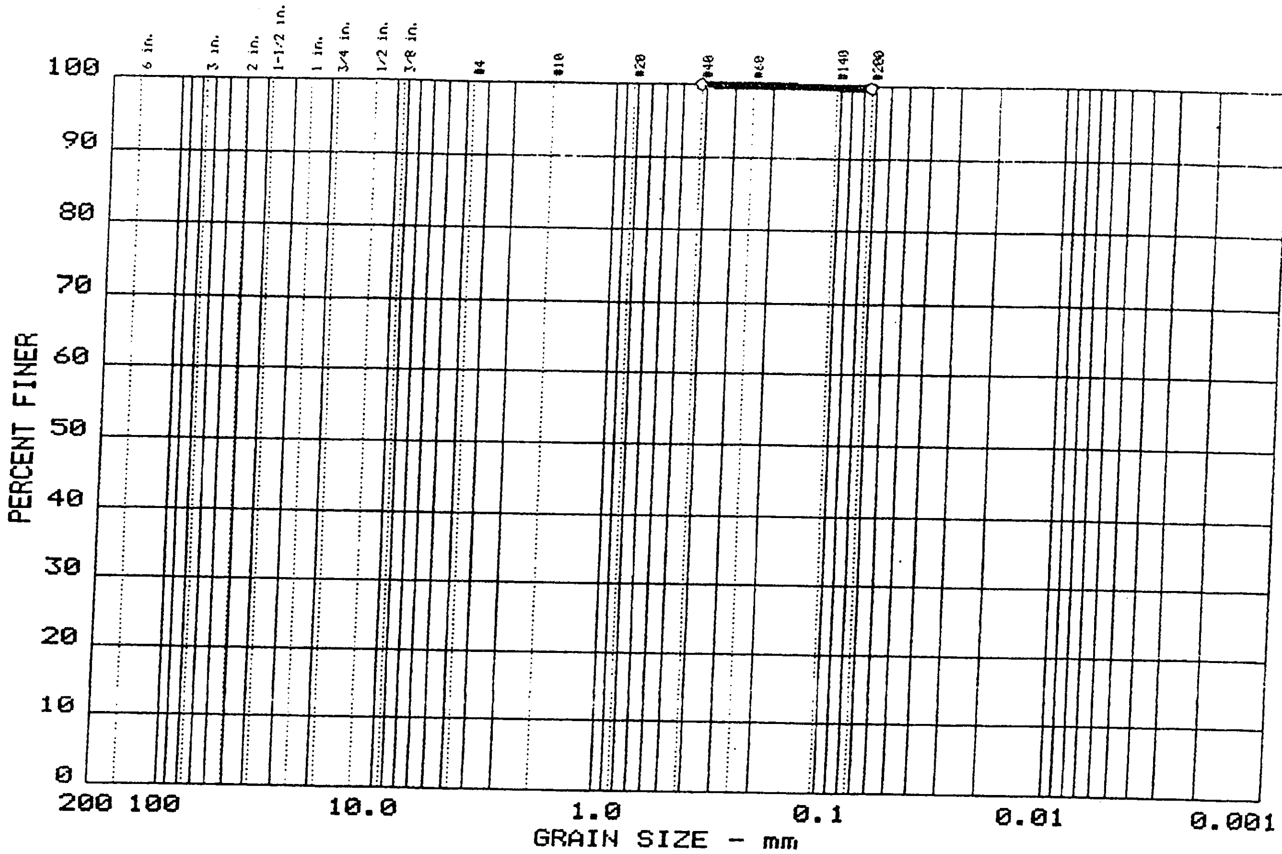
Date: 05-07-97

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. ES-MPUC-1

Fig. No.______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	0.3	99.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

MATERIAL DESCRIPTION	USCS	AASHTO
○ ORGANIC SILT,VERY DARK GRAY	OH	

Project No.:
Project: MARTIN PENA CHANNEL
○ **Location:** SAN JUAN PR.

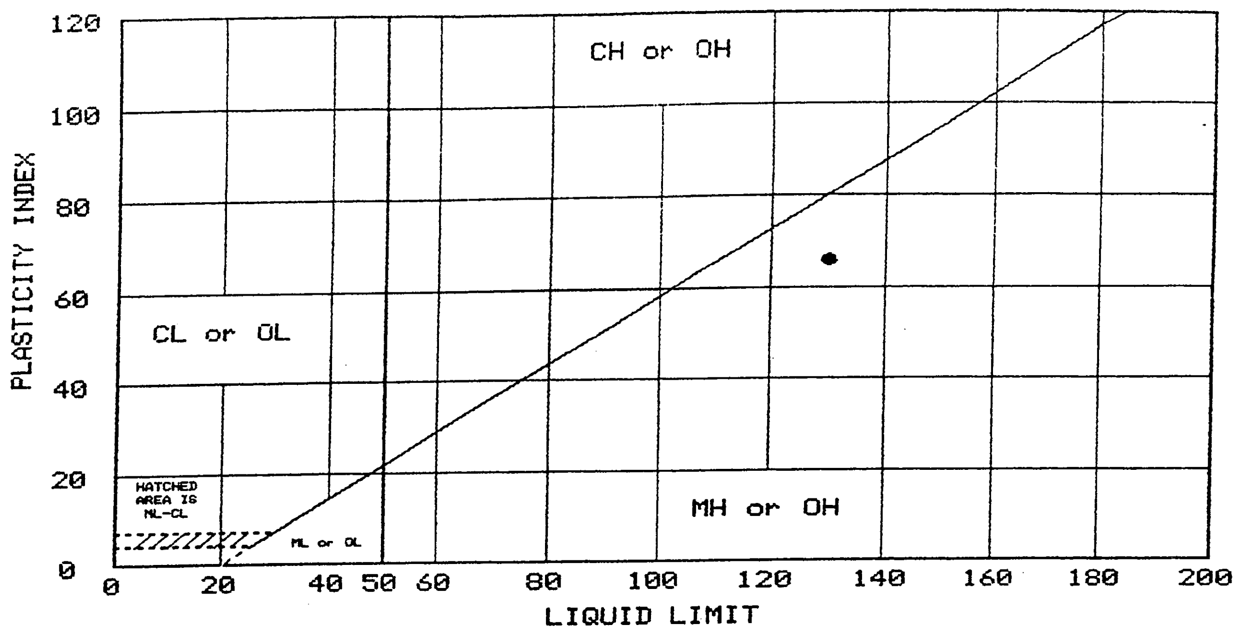
Date: 05-08-97

Remarks:
BOR ES-MPUC-2

GRAIN SIZE DISTRIBUTION TEST REPORT
SUELOS INC.

Figure No.______

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	ORGANIC SILT,VERY DARK GRAY	130	64	66		OH	

Project No.:
Project: MARTIN PENA CHANNEL

Client: ROY F. WESTON
Location: SAN JUAN P.R.

Date: 05-07-97

LIQUID AND PLASTIC LIMITS TEST REPORT
SUELOS INC.

Remarks:
BOR. ES-MPUC-2

Fig. No.____

DREDGING OF CAÑO MARTÍN PEÑA
PUERTO RICO
FINAL
PROJECT DESIGN REPORT AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX B
GEOTECHNICAL INVESTIGATIONS
LABORATORY WORK REPORT
BY SUELOS, INC.

LABORATORY WORK REPORT

PROJECT: Martin Pena
STATUS: Completed
BORING: CB-MPUC-C8

Boring No.	Sample No.	Depth Ft.	Visual Description
CB-MPUC-C8	10	17.5-19.0	Silts sandy, light olive brown very soft (ML).

LABORATORY WORK REPORT

PROJECT: Martin Pena
STATUS: Completed
BORING: CB-MPUC-C10

Boring No.	Sample No.	Depth No.	Visual Description
CB-MPUC-C10	4	7.5-9.0	Organic Silts, black (OL)

PROJECT :**Martin PeÑa Channel**
CLIENT: **Roy F. Weston**
RE: **Moisture percent**

BORING	**DEPTH**	**MOIUSTURE %**
CB-MPUC-L4	25.5'-27.0'	34
CB-MPVC-L1	12.0'-13.5'	23
CB-MPVC-L1	16.5'-18.0'	19
CB-MPVC-L1	22.5'-24.0'	33
CB-MPVC-L1	27.0'-28.5'	30
CB-MPVC-L1	31.5'-33.0'	29
CB-MPUC-L2	15.0'-16.5'	39
CB-MPUC-L2	18.0'-19.5'	45
CB-MPUC-L2	25.5'-27.0'	30
CB-MPUC-L2	40.5'-42.0'	33
CB-MPUC-L3	3.0'-4.5'	17
CB-MPUC-L3	7.5'-9.0'	155
CB-MPUC-L3	21.0'22.5'	35
CB-MPUC-L3	45.0'46.5'	12
CB-MPUC-C1	6.5'-8.0'	217
CB-MPUC-C2	7.0'-8.5'	80
CB-MPUC-C3	9.0'-10.5'	30
CB-MPUC-C5	7.5'-9.0'	153
CB-MPUC-C6	9.5'-11.0'	*NO SAMPLE AVALIABLE
CB-MPUC-C7	7.5'-9.0'	36
CB-MPUC-C7	9.0'-10.5'	22
CB-MPUC-C8	5.5'-7.0'	293
CB-MPUC-C10	4.5'-6.0'	139
ES-MPUC-1		138
ES-MPUC-2		130
CB-MPUC-C10R	4.5'-6.0'	345

SUELOS INC.
FIGUEROA 611
SANTURCE P.R.

PROJECT: MARTIN PENA CHANNEL
LOCATION SAN JUAN P.R.
CLIENT: ROY F. WESTON

DATE: 05/02/97

BOR. NO.	SAMPLE	DEPTH	SPECIFIC GRAVITY
CB-MPUC-L4	18	25.5-27.0'	2.53
CB-MPUC-L5	2	1.5-3.0'	2.63
CB-MPUC-L2	3	3.0-4.5'	2.62
CB-MPUC-L3	3	3.0-4.5'	2.48

PROJECT : **Martin PeÑa Channel**
CLIENT: **Roy F. Weston**
RE: **SPECIFIC GRAVITY**

BORING	DEPTH	S. GRAVITY
CB-MPUC-C7	7.5'-9.0	2.63
CB-MPUC-L3	7.5'-9.0'	1.74
CB-MPUC-L3	21.0'-22.5'	2.446
ES-MPUC-1		1.92
CB-MPUC-C3	9.0'-10.5'	2.571
CB-MPUC-C2	7.0'-8.5'	2.50

SUELOS INC.
FIGUEROA 611
SANTURCE P.R.

PROJECT: MARTIN PENA CHANNEL   DATE: 05/09/97
LOCATION SAN JUAN P.R.
CLIENT: ROY F. WESTON

BOR. NO.	SAMPLE	DEPTH	SPECIFIC GRAVITY
CB-MPUC-C9	3	7.5-9.0'	1.87

LABORATORY WORK REPORT

PROJECT: Martin Pena
STATUS: Completed
BORING: CB-MPUC-L1

Boring Number	Sample No.	Depth Ft.	Visual Description
CB-MPUC-L1	5	6.0-7.5	Peat, fibrous, dark brown to black (PT).
CB-MPUC-L1	14	19.5-21.0	Peat, fibrous, dark brown to black (PT).
CB-MPUC-L1	23	33.0-34.5	Clay,trace silts,very stiff, dark reddish brown (CH).
CB-MPUC-L1	27	39.0-41.5	Clay,trace silts, dark reddish brown (CH).
CB-MPUC-L1	34	49.5-51	Sand, silty pale yellow (SM).

LABORATORY WORK REPORT

PROJECT: Martin Pena
STATUS: Completed
BORING: CB-MPUC-L2

Boring No.	Sample No.	Depth Ft.	Visual Description
CB-MPUC-L2	4	4.5-6.0	Sand, silty coarse grained, little clay, some gravel brown (SM).
CB-MPUC-L2	5	6.0-7.5	Sand, silty coarse grained, little clay, some gravel brown (SM).
CB-MPUC-L2	10	13.5-15.0	Peat, fibrousous, some organic silts, few shell fragments, very dark to brown (PT).
CB-MPUC-L2	14	19.5-21.0	Clay, little silts ,traces of fine sand(CH).
CB-MPUC-L2	32	46.5-48.0	Clay, little silts ,traces of fine sand(CH).

LABORATORY WORK REPORT

PROJECT: Martin Pena
STATUS: Completed
BORING: CB-MPUC-L3

Boring Number	Sample No.	Depth Ft.	Visual Description
CB-MPUC-L3	4	4.5-6.0	Silts,sandy, light olive brown, very soft (ML).
CB-MPUC-L3	7	9.0-10.5	Peat, fibrous, dark gray to black (PT).
CB-MPUC-L3	12	16.5-18	Silts, clayey, yellowish brown , some oxidation (MH).
CB-MPUC-L3	18	25.5-27.0	Clay sandy, reddish brown, trace fine sand, very stiff (CH).
CB-MPUC-L3	20	28.5-30.0	Clay, very stiff, light gray some reddissh material (CH).
CB-MPUC-L3	23	33.0-34.5	Clay, dark yellowish brown, very stiff, trace fine sand.(CH).
CB-MPUC-L3	36	52.5-54.0	Clay, yellowish brown- reddish brown, very stiff (CH).

LABORATORY WORK REPORT

PROJECT: Martin Pena
STATUS: Completed
BORING: CB-MPUC-L4

Boring No.	Sample No.	Depth Ft.	Visual Description
CB-MPUC-L4	13	18.0-19.5	Silts, sandy, some clay highly plastic, some grave, limestone fragments, yellowish brown (ML).
CB-MPUC-L4	17	24.0-25.5	Sand, clayey, some silty clay pockets, few limestone gravel, yellowish brown (SC).
CB-MPUC-L4	24	34.5-36.0	Gravel, silty,some clay, calcareous, some sand,pale yellowish brown (GM).
CB-MPUC-L4	28	40.5-42.0	Clay, sandybrown , some coarse sand,some limestone fragmnets(CL).
CB-MPUC-L4	33	48.0-48.5	Clay, sandy, some limestone gravel, yellowish brown (CL).

LABORATORY WORK REPORT

PROJECT: Martin Pena
STATUS: Completed
BORING: CB-MPUC-C1

Boring No.	Sample No.	Depth No.	Visual Description
CB-MPUC-C1	6	12.5-14.0	Silts , organic, olive gray (OL).

LABORATORY WORK REPORT

PROJECT: Martin Pena
STATUS: Completed
BORING: CB-MPUC-C2

Boring No.	Sample No.	Depth No.	Visual Description
CB-MPUC-C2	1	4.0-5.5	Sand, silty moderateraly organic, very darkgray (SM).
CB-MPUC-C2	10	17.5-19.0	Clay,light gray trace silts stiff (CL).

LABORATORY WORK REPORT

PROJECT: Martin Pena
STATUS: Completed
BORING: CB-MPUC-C3

Boring No.	Sample No.	Depth No.	Visual Description
CB-MPUC-C3	9	18.5-19.5	Clay , sandy, yellowish brown, Trace fine sand very stiff (CL).

LABORATORY WORK REPORT

PROJECT: Martin Pena
STATUS: Completed
BORING: CB-MPUC-C5

Boring No.	Sample No.	Depth No.	Visual Description
CB-MPUC-C5	10	19.5-21.0	Clay, silty, reddish brown, trace fine sand (CH).

LABORATORY WORK REPORT

PROJECT: Martin Pena
STATUS: Completed
BORING: CB-MPUC-C6

Boring Number	Sample No.	Depth Ft.	Visual Description
CB-MPUC-C6	4	9.5-11.0	No sample availiable
CB-MPUC-C6	7	14.0-15.5	Clay, Sandy, Ligth olive brown, mediun stiff, trace fine sand (CH).

LABORATORY WORK REPORT

PROJECT: Martin Pena
STATUS: Completed
BORING: CB-MPUC-C7

Boring No.	Sample No.	Depth No.	Visual Description
CB-MPUC-C7	5	12.0-13.5	Clay , silty reddish brown some gray clay, very stif (CH).

DREDGING OF CAÑO MARTÍN PEÑA
PUERTO RICO
FINAL
PROJECT DESIGN REPORT AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX B
GEOTECHNICAL INVESTIGATIONS
BORING LOGS
BY GEO CIM, INC.

Hole No.CB-MP98-01

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 3
1. PROJECT Martin Pena Project, San Juan, P.R.		10. SIZE AND TYPE OF BIT See Remarks	
2. LOCATION (Coordinates or Station) X=629,285 Y=218,943		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY GEO CIM, INC.		12. MANUFACTURER'S DESIGNATION OF DRILL CME-55	
4. HOLE NO. (As shown on drawing title and file number) CB-MP98-01		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 34 undisturbed: 0	
5. NAME OF DRILLER CARLOS CALDERON		14. TOTAL NUMBER OF CORE BOXES 1	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED		15. ELEVATION GROUND WATER -1.18 Ft.	
		16. DATE HOLE STARTED 04/29/98 COMPLETED 04/29/98	
7. THICKNESS OF BURDEN 51.0 Ft.		17. ELEVATION TOP OF HOLE 3.321 Ft.	
8. DEPTH DRILLED INTO ROCK 0 Ft.		18. TOTAL CORE RECOVERY FOR BORING 93.5 %	
9. TOTAL DEPTH OF HOLE 51.0 Ft.		19. SIGNATURE OF ENGINEER Jorge R. Parra, P.E. JRP	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
3.3	.0					3.3	
			FILL consisting of gravelly SAND with some to little clay, very dense, medium to coarse sand, brown. (SP)	33.3	1	SPLIT SPOON 1.8	7 / 31 / 18
			-medium dense.	55.6	2	SPLIT SPOON .3	11 / 8 / 6
-1.2	4.5		-little black organic clay.	100	3	SPLIT SPOON -1.2	3 / 2 / 3
-2.7	6.0		Quartz SAND with trace silt, loose, poorly graded, subangular, medium sand, dark brown to brown. (SP)	88.9	4	SPLIT SPOON -2.7	4 / 2 / 4
-4.2	7.5		Brown SAND, some gray clay, medium dense. (SC)	94.4	5	SPLIT SPOON -4.2	6 / 7 / 8
-5.7	9.0		Clayey Quartz SAND, medium dense, poorly graded, medium sand, gray. (SC)	94.4	6	SPLIT SPOON -5.7	6 / 7 / 8
			Clayey Quartz SAND, medium dense, gray. (SC)	100	7	SPLIT SPOON -7.2	5 / 9 / 10
			-as above.	100	8	SPLIT SPOON -8.7	9 / 11 / 11
				100	9	SPLIT SPOON -10.2	5 / 6 / 7
				94.4	10	SPLIT SPOON -11.7	3 / 6 / 5
				100	11	SPLIT SPOON -13.2	9 / 11 / 11
-14.7	18.0			94.4	12	SPLIT SPOON -14.7	4 / 7 / 9
-16.2	19.5		CLAY with little quartz sand, very stiff, gray. (CH)	100	13	SPLIT SPOON -16.2	7 / 10 / 16
-17.7	21.0		Sandy CLAY, stiff, gray; sand consists of quartz sand. (CL)	100	14	SPLIT SPOON -17.7	4 / 12 / 17
			CLAY with trace quartz sand, very stiff, gray. (CH)	100	15	SPLIT SPOON -19.2	7 / 11 / 15
						(continued)	

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.CB-MP98-01

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE	SHEET 2 OF 3
3.321 Ft.	

PROJECT	INSTALLATION
Martin Pena Project, San Juan, P.R.	Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
-19.2	22.5					-19.2	
			-as above. -little quartz sand.	88.9	16	SPLIT SPOON -20.7	7 14 11
			-little to some quartz sand.	88.9	17	SPLIT SPOON -22.2	7 7 12
-23.7	27.0			94.4	18	SPLIT SPOON -23.7	9 13 15
			CLAY with little quartz sand, very stiff, brown. (CH) -gray to brown.	100	19	SPLIT SPOON -25.2	7 10 12
			-brown, hard.	100	20	SPLIT SPOON -26.7	4 10 12
			-some sand.	100	21	SPLIT SPOON -28.2	10 16 18
-29.7	33.0			100	22	SPLIT SPOON -29.7	10 16 17
-31.2	34.5		Quartz SAND with little clay, poorly graded, dense, medium sand, brown. (CH)	88.9	23	SPLIT SPOON -31.2	10 13 20
			CLAY with trace to little quartz sand, hard, brown. (CH) -very stiff.	88.9	24	SPLIT SPOON -32.7	6 16 21
			-trace decomposed wood fragments, trace sand.	100	25	SPLIT SPOON -34.2	7 10 16
			-no wood fragments.	94.4	26	SPLIT SPOON -35.7	9 10 15
			-hard.	100	27	SPLIT SPOON -37.2	10 13 15
-38.7	42.0			100	28	SPLIT SPOON -38.7	6 13 19
-40.2	43.5		-trace decomposed wood fragments; quartz sand lense.	100	29	SPLIT SPOON -40.2	9 13 17
			-very stiff, no sand lense. (CH) -trace quartz sand.	94.4	30	SPLIT SPOON -41.7	8 10 18
			-as above.	88.9	31	SPLIT SPOON -43.2	5 7 16
			-as above	94.4	32	SPLIT SPOON -44.7	6 8 10
			-hard	100	33	SPLIT SPOON -46.2	6 8 11
				100	34	SPLIT SPOON (continued)	12

Depth scale: 22.5, 25, 27.5, 30, 32.5, 35, 37.5, 40, 42.5, 45, 47.5, 50

Hole No.CB-MP98-01

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 3.321 Ft. | SHEET 3 OF 3

PROJECT: Martin Pena Project, San Juan, P.R.

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-46.7	50.0						
-47.7	51.0			100	34	SPLIT SPOON -47.7	14 / 16

END OF BORING CB-MP98-01 AT 51.0 FEET DEPTH.

NOTES:

Soils are field visually classified in accordance with the Unified Soils Classification System.

140# Hammer with 30" drop used on 2.0 foot split spoon (1-3/8" I.D. x 2" O.D.)

Sample No.	Moisture Content%	Spec. Grav.	Att. Limits L.L%	Att. Limits P.I%
5	22.7	--	--	--
10	16.9	2.65	26.8	14.1
19	26.8	2.69	84.0	59.1
25	34.6	--	--	--
26	33.7	--	--	--
30	42.4	2.82	97.2	63.6

-50 -52.5 -55 -57.5 -60 -62.5 -65 -67.5 -70 -72.5 -75 -77.5

Hole No.CB-MP98-02

DRILLING LOG — DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 3
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=629,360 Y=218,705	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: CME-55
4. HOLE NO. (As shown on drawing title and file number): CB-MP98-02	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 34 undisturbed: 0
5. NAME OF DRILLER: CARLOS CALDERON	14. TOTAL NUMBER OF CORE BOXES: 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: 0.386 Ft.
	16. DATE HOLE: STARTED 04/30/98 COMPLETED 04/30/98
7. THICKNESS OF BURDEN: 51.0 Ft.	17. ELEVATION TOP OF HOLE: 6.386 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 82.8 %
9. TOTAL DEPTH OF HOLE: 51.0 Ft.	19. SIGNATURE OF ENGINEER: Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
6.4	.0					6.4	
			FILL consisting of gravelly CLAY with some silt, medium stiff, brown. (GC) -some construction rubble, soft to medium stiff.	88.9	1	SPLIT SPOON (to 4.9)	4 / 3 / 3
			-hard due to the presence of boulders and construction debris.	11.1	2	SPLIT SPOON (to 3.4)	3 / 2 / 2
				33.3	3	SPLIT SPOON (to 1.9)	3 / 4 / 100
.4	6.0		-no recovery due to the presence of a boulder.	0	4	SPLIT SPOON (to .4)	100
-1.1	7.5		SAND with some silt, medium dense, poorly graded, medium to coarse, brown; some gravel consisting of brick fragments. (SM)	55.6	5	SPLIT SPOON (to -1.1)	7 / 6 / 6
-2.6	9.0		Silty SAND, medium dense, dark gray, trace organic content. (SM)	66.7	6	SPLIT SPOON (to -2.6)	4 / 4 / 4
			SAND trace silt and gravel, very loose, poorly graded, coarse to medium sand, dark brown to black, gravel consists of cemented sand nodules. (SP-SM)	55.6	7	SPLIT SPOON (to -4.1)	3 / 1 / 1
			-trace organic matter -little shell fragments, loose.	77.8	8	SPLIT SPOON (to -5.6)	1 / 2 / 2
-7.1	13.5		-silty.	72.2	9	SPLIT SPOON (to -7.1)	1 / 1 / 3
			CLAY, some sand, medium stiff, gray; trace decomposed plant fragments. (CL) -hard.	94.4	10	SPLIT SPOON (to -8.6)	P / 2 / 5
			-very stiff.	100	11	SPLIT SPOON (to -10.1)	10 / 18 / 21
			-as above.	100	12	SPLIT SPOON (to -11.6)	8 / 12 / 16
			-as above.	94.4	13	SPLIT SPOON (to -13.1)	8 / 10 / 12
			-some to little sand, stiff.	100	14	SPLIT SPOON (to -14.6)	8 / 12 / 16
				88.9	15	SPLIT SPOON (to -16.1)	4 / 4 / 7
						(continued)	

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.CB-MP98-02

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 6.386 Ft.	SHEET 2 OF 3
PROJECT Martin Pena Project, San Juan, P.R.	INSTALLATION Jacksonville District	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-16.1	22.5					-16.1	
-17.6	24.0		-as above.	94.4	16	SPLIT SPOON -17.6	5 8 8
-19.1	25.5		Clayey SAND, medium dense, poorly graded, medium sand, gray. (SC)	88.9	17	SPLIT SPOON -19.1	3 3 9
			CLAY with little to trace sand, hard, high plasticity, brown to reddish brown. (CH)	94.4	18	SPLIT SPOON -20.6	10 16 21
			-very stiff.	100	19	SPLIT SPOON -22.1	8 10 12
			-as above.	100	20	SPLIT SPOON -23.6	8 10 13
			-trace to no sand.	94.4	21	SPLIT SPOON -25.1	5 11 14
-26.6	33.0		-hard.	100	22	SPLIT SPOON -26.6	9 12 21
-28.1	34.5		Silty SAND, medium to coarse, medium dense, poorly graded, brown to gray. (SM)	88.9	23	SPLIT SPOON -28.1	8 14 13
			High Plasticity CLAY with some sand, very stiff, brown to purple, little decomposed plant fragments. (CH)	94.4	24	SPLIT SPOON -29.6	5 9 12
			-trace sand.	88.9	25	SPLIT SPOON -31.1	8 13 13
-32.6	39.0		-some sand and gravel consisting of cemented sand nodules.	88.9	26	SPLIT SPOON -32.6	20 9 19
			SAND with trace silt, poorly-graded, medium dense, medium to coarse sand, angular to subangular, pale brown. (SP-SM)	88.9	27	SPLIT SPOON -34.1	6 9 10
			-as above.	83.3	28	SPLIT SPOON -35.6	6 8 10
			-as above.	84.4	29	SPLIT SPOON -37.1	8 8 10
			-no silt.	94.4	30	SPLIT SPOON -38.6	7 9 12
			-coarse.	88.9	31	SPLIT SPOON -40.1	5 6 11
			-trace silt.	100	32	SPLIT SPOON -41.6	5 8 10
-43.1	49.5		-as above.	100	33	SPLIT SPOON -43.1	10 13 14
			Sandy CLAY, very stiff, brown to gray. (CL)	94.4	34	SPLIT SPOON (continued)	8

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 6.386 Ft.

PROJECT Martin Pena Project, San Juan, P.R.

INSTALLATION Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-43.6	50.0						
-44.6	51.0			94.4	34	SPLIT SPOON -44.6	8 11
			END OF BORING CB-MP98-02 AT 51.0 FEET DEPTH.				

NOTES:

Soils are field visually classified in accordance with the Unified Soils Classification System.

140# Hammer with 30" drop used on 2.0 foot split spoon (1-3/8" I.D. x 2" O.D.)

Sample No.	Moisture Content%	Spec. Grav.	Att. Limits L.L.	P.I.
8	23.9	--	--	--
13	19.9	--	--	--
15	19.9	2.66	34.5	19.9
20	35.1	2.88	87.0	56.1
25	34.0	2.80	107.0	75.5
28	19.5	2.66	--	--

Sample No.	Organic Content
8	3.41%

-50 -52.5 -55 -57.5 -60 -62.5 -65 -67.5 -70 -72.5 -75 -77.5

Hole No.CB-MP98-03

DRILLING LOG

DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 3
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=630,015 Y=218,690	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: CME-55
4. HOLE NO. (As shown on drawing title and file number): CB-MP98-03	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 34 undisturbed: 0
5. NAME OF DRILLER: CARLOS CALDERON	14. TOTAL NUMBER OF CORE BOXES: 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: -0.488 Ft.
	16. DATE HOLE: STARTED 04/28/98 COMPLETED 04/28/98
7. THICKNESS OF BURDEN: 51.0 Ft.	17. ELEVATION TOP OF HOLE: 4.512 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 95 %
9. TOTAL DEPTH OF HOLE: 51.0 Ft.	19. SIGNATURE OF ENGINEER: Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
4.5	.0					4.5	
			FILL, consisting of GRAVEL with some red clay, dense, angular, well graded, brown to gray; gravel consist of concrete fragments. (GW)	66	1	SPLIT SPOON 3.0	6 13 18
1.5	3.0		-medium dense.	56	2	SPLIT SPOON 1.5	5 10 8
.0	4.5		FILL consisting of Silty CLAY with little gravel and trace clay, stiff, brown. (ML)	78	3	SPLIT SPOON .0	5 5 4
-1.5	6.0		FILL consisting of GRAVEL with some to little clay, medium dense, well graded, subrounded, brown to reddish brown; trace trash. (GW)	67	4	SPLIT SPOON -1.5	5 4 11
-3.0	7.5		FILL-GRAVEL, with trace clay, well-graded, medium dense, angular, dark gray, little plant fragments. (GW)	45	5	SPLIT SPOON -3.0	5 4 4
-4.5	9.0		FILL-Root and plant fragments with trace silt, black.	17	6	SPLIT SPOON -4.5	8 2 2
-6.0	10.5		FILL-Organic CLAY with trace sand, high plasticity, very soft, black, strong organic odor. (OH)	45	7	SPLIT SPOON -6.0	P 1 1
-7.5	12.0		FILL-Organic Clayey Sand, little gravel, high content of trash and wood fragments, very soft. (SC)	28	8	SPLIT SPOON -7.5	P P P
-9.0	13.5		Organic CLAY, little sand, very soft, black. (OH)	50	9	SPLIT SPOON -9.0	P P P
-10.5	15.0		PEAT with some sandy silt, very soft, dark brown. (Pt)	67	10	SPLIT SPOON -10.5	P P 2
-12.0	16.5		Clayey SAND with some peat, medium sand, very loose, well graded, gray to black. (SC)	61	11	SPLIT SPOON -12.0	P P 2
-13.5	18.0		Sandy CLAY with little decomposed plant fragments, soft, pale brown to gray. (CL)	94	12	SPLIT SPOON -13.5	1 2 2
			SAND with trace silt, loose, medium sand, poorly graded, grayish brown. (SP)	61	13	SPLIT SPOON -15.0	3 2 3
-16.5	21.0		-some clay, medium dense.	67	14	SPLIT SPOON -16.5	5 9 12
			Clayey SAND, medium dense, medium sand, poorly graded, gray. (SC)	78	15	SPLIT SPOON -18.0	7 11 17
						(continued)	

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.CB-MP98-03

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 4.512 Ft.

SHEET 2 OF 3

PROJECT: Martin Pena Project, San Juan, P.R.

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-18.0	22.5					-18.0	
			-as above.	67	16	SPLIT SPOON -19.5	7 9 13
-19.5	24.0		High plasticity CLAY with trace sand, very stiff, gray. (CH)	83	17	SPLIT SPOON -21.0	5 7 13
			-little sand.	100	18	SPLIT SPOON -22.5	7 10 14
			-little to some sand.	100	19	SPLIT SPOON -24.0	7 9 11
-24.0	28.5		Sandy CLAY, very stiff, brown. (CL)	100	20	SPLIT SPOON -25.5	4 6 11
				94	21	SPLIT SPOON -27.0	4 6 9
			-sandy clay, stiff, dark yellowish brown. (CL)	89	22	SPLIT SPOON -28.5	6 6 8
-28.5	33.0		CLAY, trace to little sand, stiff, brown to dark brown. (CL)	83	23	SPLIT SPOON -30.0	6 7 7
			-as above.	78	24	SPLIT SPOON -31.5	6 8 8
			-low plasticity	94	25	SPLIT SPOON -33.0	7 8 10
				89	26	SPLIT SPOON -34.5	7 9 12
			-brown to reddish brown.	72	27	SPLIT SPOON -36.0	10 14 15
-36.0	40.5		High Plasticity SILT, very stiff, brown to reddish brown. (MH)	89	28	SPLIT SPOON -37.5	8 10 15
				74	29	SPLIT SPOON -39.0	8 11 14
			-hard.	100	30	SPLIT SPOON -40.5	10 15 15
				100	31	SPLIT SPOON -42.0	4 7 11
				83	32	SPLIT SPOON -43.5	11 13 18
				74	33	SPLIT SPOON -45.0	8 11 16
				83	34	SPLIT SPOON	7
						(continued)	

Depth scale: 22.5, 25, 27.5, 30, 32.5, 35, 37.5, 40, 42.5, 45, 47.5, 50

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Martin Pena Project, San Juan, P.R. | HOLE NUMBER: CB-MP98-03

Hole No.CB-MP98-03

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 4.512 Ft.

SHEET 3 OF 3

PROJECT Martin Pena Project, San Juan, P.R.

INSTALLATION Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-45.5	50.0						
-46.5	51.0			83	34	SPLIT SPOON -46.5	14 / 14
			END OF BORING CB-MP98-03 AT 51.0 FEET DEPTH.				

NOTES:

Soils are field visually classified in accordance with the Unified Soils Classification System.

140# Hammer with 30" drop used on 2.0 foot split spoon (1-3/8" I.D. x 2" O.D.)

P=sampler was pushed into the ground only by the weight of the hammer.

Sample No.	Moisture Content%	Spec. Grav.	Att. Limits L.L%	P.I%
8	95.3	--	--	--
17	31.7	2.63	69.0	42.3
21	21.9	2.68	--	--
25	27.7	2.54	46.5	25.8
28	35.5	--	74.0	34.1

Sample No.	Organic Content%
8	29.47

-50 -52.5 -55 -57.5 -60 -62.5 -65 -67.5 -70 -72.5 -75 -77.5

Hole No.CB-MP98-04

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 3

1. PROJECT Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT See Remarks
2. LOCATION (Coordinates or Station) X=630,435 Y=219,065	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL CME-55
4. HOLE NO. (As shown on drawing title and file number) CB-MP98-04	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 34 undisturbed: 0
5. NAME OF DRILLER CARLOS CALDERON	14. TOTAL NUMBER OF CORE BOXES 1
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER -0.626 ft.
	16. DATE HOLE STARTED 05/08/98 COMPLETED 05/08/98
7. THICKNESS OF BURDEN 51.0 Ft.	17. ELEVATION TOP OF HOLE 2.374 Ft.
8. DEPTH DRILLED INTO ROCK 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING 89.7 %
9. TOTAL DEPTH OF HOLE 51.0 Ft.	19. SIGNATURE OF ENGINEER Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
2.4	.0					2.4	
.9	1.5		FILL-GRAVEL, little clay, trace sand, medium dense, brown. (GC)	78.8	1	SPLIT SPOON .9	8, 9, 7
			FILL-CLAY, little gravel, trace sand, stiff, brown, pale yellow. (CH)	61.1	2	SPLIT SPOON -.6	5, 4, 4
-2.1	4.5			13.9	3	SPLIT SPOON -2.1	5, 4, 4
			ORGANIC CLAY, some organic matter, very soft, black. (OH) -some organic matter and peat.	88.9	4	SPLIT SPOON -3.6	1, P, 1
				100	5	SPLIT SPOON -5.1	1, 1, 1
				100	6	SPLIT SPOON -6.6	P, P, P
				100	7	SPLIT SPOON -8.1	P, P, P
-9.6	12.0		-no peat.	100	8	SPLIT SPOON -9.6	3, 5, 4
			High Plasticity CLAY, trace organic matter, medium stiff to hard, gray, brown. (CH)	77.8	9	SPLIT SPOON -11.1	P, 3, 3
				88.9	10	SPLIT SPOON -12.6	3, 4, 8
				88.9	11	SPLIT SPOON -14.1	10, 12, 12
			-no organic matter.	88.9	12	SPLIT SPOON -15.6	3, 6, 10
			-brown.	88.9	13	SPLIT SPOON -17.1	6, 8, 14
			-red brown, yellow, high plasticity.	94.4	14	SPLIT SPOON -18.6	3, 5, 7
				100	15	SPLIT SPOON -20.1	9, 15, 17
						(continued)	

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.CB-MP98-04

DRILLING LOG (Cont. Sheet) | ELEVATION TOP OF HOLE: 2.374 Ft. | SHEET 2 OF 3

PROJECT: Martin Pena Project, San Juan, P.R. | INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-20.1	22.5		~~brown, red.~~			-20.1	
				100	16	SPLIT SPOON -21.6	7 12 14
				77.8	17	SPLIT SPOON -23.1	9 15 18
			-brown	100	18	SPLIT SPOON -24.6	9 12 14
				100	19	SPLIT SPOON -26.1	9 15 16
-27.6	30.0			100	20	SPLIT SPOON -27.6	8 12 15
			High Plasticity SILT, very stiff, dark yellowish brown. (MH)	100	21	SPLIT SPOON -29.1	3 6 11
-30.6	33.0			94.4	22	SPLIT SPOON -30.6	10 15 15
			High Plasticity CLAY, hard, brown to yellowish brown. (CH)	100	23	SPLIT SPOON -32.1	9 14 17
				100	24	SPLIT SPOON -33.6	9 14 15
				94.4	25	SPLIT SPOON -35.1	10 14 16
				100	26	SPLIT SPOON -36.6	8 13 14
-38.1	40.5			100	27	SPLIT SPOON -38.1	8 10 12
			Limestone Formation sampled as CLAY, some gravel, little silt, trace sand, hard, yellowish brown, pale yellow. (CH)	94.4	28	SPLIT SPOON -39.6	6 12 20
			-sampled as sandy clay, little gravel. (CH)	100	29	SPLIT SPOON -41.1	5 5 10
			-little sand	77.8	30	SPLIT SPOON -42.6	3 4 6
				94.4	31	SPLIT SPOON -44.1	9 12 15
			-sampled as hard limestone fragments, little clay and silt, little sand, brown, pale yellow. (GW)	88.9	32	SPLIT SPOON -45.6	18 19 19
				77.8	33	SPLIT SPOON -47.1	12 17 16
			-sampled as CLAY, little gravel ~~(limestone), little silt, trace sand, brown, pale yellow. (CL)~~	77.8	34	SPLIT SPOON	7
						(continued)	

Depth scale: 22.5, 25, 27.5, 30, 32.5, 35, 37.5, 40, 42.5, 45, 47.5, 50

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Martin Pena Project, San Juan, P.R. | HOLE NUMBER: CB-MP98-04

Hole No.CB-MP98-04

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE	SHEET 3 OF 3
2.374 Ft.	

PROJECT	INSTALLATION
Martin Pena Project, San Juan, P.R.	Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-47.6	50.0						
-48.6	51.0			77.8	34	SPLIT SPOON	12 / 11

END OF BORING CB-MP98-04 AT 51.0 FEET DEPTH.

NOTES:

Soils are field visually classified in accordance with the Unified Soils Classification System.

140# Hammer with 30" drop used on 2.0 foot split spoon (1-3/8" I.D. x 2" O.D.)

Sample No.	Moisture Content%	Spec. Gravity	Att. Limits L.L.	P.I.
6	219.5	1.72	--	--
14	32.9	--	--	--
15	30.7	2.80	82.5	51.8
17	27.9	--	--	--
22	36.2	2.73	83.2	41.7
29	28.3	--	--	--

Sample No.	Organic Content
6	75.92%

50 52.5 55 57.5 60 62.5 65 67.5 70 72.5 75 77.5

Hole No.CB-MP98-05

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 3

1. PROJECT Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT See Remarks
2. LOCATION (Coordinates or Station) X=630,353 Y=218,801	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL CME-55
4. HOLE NO. (As shown on drawing title and file number) CB-MP98-05	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 34 undisturbed: 0
5. NAME OF DRILLER CARLOS CALDERON	14. TOTAL NUMBER OF CORE BOXES 1
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER -1.749 Ft.
	16. DATE HOLE STARTED 05/01/98 COMPLETED 05/01/98
7. THICKNESS OF BURDEN 51.0 Ft.	17. ELEVATION TOP OF HOLE 2.751 Ft.
8. DEPTH DRILLED INTO ROCK 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING 86.4 %
9. TOTAL DEPTH OF HOLE 51.0 Ft.	19. SIGNATURE OF ENGINEER Jorge R. Parra, P.E. JRP

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
2.8	.0					2.8	
			FILL-CLAY, trace sand, stiff, yellowish brown. (CL)	88.9	1	SPLIT SPOON	2, 5, 5
			-little silt, interlayer of sand.			1.3	
				77.8	2	SPLIT SPOON	7, 7, 6
-.2	3.0					-.2	
			FILL-sandy-gravelly CLAY, (clay is soft), dark brown, reddish yellow.	50	3	SPLIT SPOON	3, 5, 9
			-as above, clayey gravel, limestone fragments; trace dark gray clay, soft. (GC)			-1.7	
				38.9	4	SPLIT SPOON	3, 1, 1
-3.2	6.0					-3.2	
			Organic clay to silty clay, fibrous, little peat, very soft. (OH)	55.6	5	SPLIT SPOON	1, 1, 1
			-as above.			-4.7	
				38.9	6	SPLIT SPOON	P, P, P
						-6.2	
				100	7	SPLIT SPOON	P, P, P
			-trace decomposed organic matter, dispersed sand.			-7.7	
				100	8	SPLIT SPOON	1, 2, 2
-9.2	12.0					-9.2	
			Low Plasticity, CLAY, trace organic matter, stiff, light gray. (CL)	88.9	9	SPLIT SPOON	2, 4, 4
			-trace roots, some sand, no organic matter.			-10.7	
				94.4	10	SPLIT SPOON	3, 5, 5
			-no roots.			-12.2	
				77.8	11	SPLIT SPOON	5, 7, 7
						-13.7	
				100	12	SPLIT SPOON	6, 8, 10
-15.2	18.0					-15.2	
			SAND, little clay, medium dense, light gray. (SC)	44.4	13	SPLIT SPOON	7, 10, 14
-16.7	19.5					-16.7	
			High Plasticity CLAY, trace sand, very stiff, dark brown. (CH)	100	14	SPLIT SPOON	9, 7, 9
			-same as above, little silt.			-18.2	
				100	15	SPLIT SPOON	8, 7, 7
						-19.7	
						(continued)	

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.CB-MP98-05

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 2.751 Ft.	SHEET 2 OF 3
PROJECT Martin Pena Project, San Juan, P.R.	INSTALLATION Jacksonville District	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-19.7	22.5					-19.7	
			-hard.	100	16	SPLIT SPOON -21.2	4 6 8
				88.9	17	SPLIT SPOON -22.7	8 16 21
				94.4	18	SPLIT SPOON -24.2	8 14 19
			-trace sand, dark yellowish brown.	100	19	SPLIT SPOON -25.7	7 10 15
				88.9	20	SPLIT SPOON -27.2	6 9 16
				100	21	SPLIT SPOON -28.7	6 11 16
				100	22	SPLIT SPOON -30.2	7 9 14
				100	23	SPLIT SPOON -31.7	6 13 17
				100	24	SPLIT SPOON -33.2	6 13 17
			-dark brown mottled.	88.9	25	SPLIT SPOON -34.7	5 9 12
			-dark brown sand lens.	100	26	SPLIT SPOON -36.2	7 11 12
				100	27	SPLIT SPOON -37.7	6 11 13
				100	28	SPLIT SPOON -39.2	6 10 12
				100	29	SPLIT SPOON -40.7	6 11 19
-42.2	45.0			94.4	30	SPLIT SPOON -42.2	6 9 9
			LIMESTONE FORMATION sampled as Thoroughly Weathered gravel in a soft, clayey-sandy matrix, quick reaction to HCL, yellowish brown. (GC)	100	31	SPLIT SPOON -43.7	2 1 2
			-sampled as sandy gravel in a stiff clay matrix.	38.9	32	SPLIT SPOON -45.2	10 14 12
			-as above, gravel is hard.	100	33	SPLIT SPOON -46.7	7 11 10
				94.4	34	SPLIT SPOON	8
						(continued)	

22.5 25 27.5 30 32.5 35 37.5 40 42.5 45 47.5 50

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT	HOLE NUMBER
Martin Pena Project, San Juan, P.R.	CB-MP98-05

Hole No.CB-MP98-05

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE	2.751 Ft.
SHEET 3 OF 3	
PROJECT	Martin Pena Project, San Juan, P.R.
INSTALLATION	Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-47.2	50.0						
				94.4	34	SPLIT SPOON -48.2	10 13
-48.2	51.0		END OF BORING CB-MP98-05 AT 51.0 FEET DEPTH.				

NOTES:

Soils are field visually classified in accordance with the Unified Soils Classification System.

140# Hammer with 30" drop used on 2.0 foot split spoon (1-3/8" I.D. x 2" O.D.)

P=sampler was pushed into the ground only by the weight of the hammer.

Sample No.	Moisture Content%	Spec. Grav.	Att. Limits L.L%	P.I%
7	145.62	2.51	--	--
10	21.5	--	45.5	25.7
15	34.6	2.68	65.5	40.3
20	31.2	2.88	78.5	46.3
25	37.8	--	--	--

Sample No.	Organic Content %
6	34.67

-50 -52.5 -55 -57.5 -60 -62.5 -65 -67.5 -70 -72.5 -75 -77.5

Hole No.CB-MP98-06

DRILLING LOG

DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 3
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=630,765 Y=218,550	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: CME-55
4. HOLE NO. (As shown on drawing title and file number): CB-MP98-06	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 34 undisturbed: 0
5. NAME OF DRILLER: CARLOS CALDERON	14. TOTAL NUMBER OF CORE BOXES: 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: -1.41 ft.
	16. DATE HOLE: STARTED 05/14/98 COMPLETED 05/14/98
7. THICKNESS OF BURDEN: 51.0 Ft.	17. ELEVATION TOP OF HOLE: 2.594 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 97.2 %
9. TOTAL DEPTH OF HOLE: 51.0 Ft.	19. SIGNATURE OF ENGINEER: JORGE R. PARRA, P.E. JRP.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
2.6	.0					2.6	
1.1	1.5		FILL-Gravel and asphalt fragments, very dense, well graded, black. (GW)	94	1	SPLIT SPOON 1.1	37, 40, 26
			FILL-Clay, some gravel and sand, very stiff, brown. (CL)	100	2	SPLIT SPOON -.4	12, 12, 13
-1.9	4.5		-stiff.	94	3	SPLIT SPOON -1.9	12, 9, 5
			Peat, some clay, fibrous, very soft, black. (Pt)	78	4	SPLIT SPOON -3.4	2, 1, 1
			-no clay.	94	5	SPLIT SPOON -4.9	P, P, P
-6.4	9.0		-trace sand.	56	6	SPLIT SPOON -6.4	4, 1, 1
			Clayey SILT, some quartz sand, gray. (ML)	100	7	SPLIT SPOON -7.9	3, 4, 5
-9.4	12.0		-as above.	100	8	SPLIT SPOON -9.4	5, 6, 7
			Sandy CLAY, stiff, gray. (CL)	100	9	SPLIT SPOON -10.9	4, 5, 6
			-very stiff, olive green to brown.	100	10	SPLIT SPOON -12.4	6, 7, 9
-13.9	16.5		-trace sand.	100	11	SPLIT SPOON -13.9	9, 12, 13
-15.4	18.0		Sandy CLAY, very stiff, gray, sand consisted of quartz sand. (CL)	100	12	SPLIT SPOON -15.4	3, 7, 9
-16.9	19.5		Quartz SAND, some silt, well-graded, medium dense, gray. (SW)	94	13	SPLIT SPOON -16.9	13, 9, 10
			High plasticity, CLAY, little to some quartz sand, very stiff, brown to gray; some decomposed plant fragments. (CH)	100	14	SPLIT SPOON -18.4	5, 10, 14
			-hard, little sand.	94	15	SPLIT SPOON -19.9	10, 18, 17
						(continued)	

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.CB-MP98-06

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 2.594 Ft.	SHEET 2 OF 3
PROJECT Martin Pena Project, San Juan, P.R.	INSTALLATION Jacksonville District	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'	
-19.9	22.5					-19.9		22.5
			-very stiff -trace sand.	100	16	SPLIT SPOON -21.4	6 11 17	
-22.9	25.5			100	17	SPLIT SPOON -22.9	5 10 17	25
-24.4	27.0		Sandy CLAY, very stiff, brown, (sand consists of quartz sand). (CL)	100	18	SPLIT SPOON -24.4	8 12 17	
			High Plasticity CLAY, hard, brown. (CH)	100	19	SPLIT SPOON -25.9	10 14 18	27.5
			-trace sand, very stiff.	100	20	SPLIT SPOON -27.4	7 11 12	30
			-no sand.	100	21	SPLIT SPOON -28.9	5 10 12	
			-as above.	100	22	SPLIT SPOON -30.4	7 10 13	32.5
			-as above.	100	23	SPLIT SPOON -31.9	8 12 12	
			-trace sand.	100	24	SPLIT SPOON -33.4	8 11 12	35
			-trace silt, reddish brown to brown.	100	25	SPLIT SPOON -34.9	9 14 15	37.5
			-brown.	100	26	SPLIT SPOON -36.4	8 11 11	
-37.9	40.5		-trace disseminated oxides.	100	27	SPLIT SPOON -37.9	6 9 10	40
-39.4	42.0		Sandy CLAY, very stiff, gray to brown; (sand consists of quartz sand). (CL)	100	28	SPLIT SPOON -39.4	8 9 9	
			High Plasticity CLAY, some silt and trace sand, very stiff, brown to dark brown. (CH)	100	29	SPLIT SPOON -40.9	9 10 13	42.5
-42.4	45.0		-some sand nodules.	100	30	SPLIT SPOON -42.4	8 10 14	45
-43.9	46.5		Sandy CLAY, stiff, brown to gray. (CL)	100	31	SPLIT SPOON -43.9	5 5 8	
-45.4	48.0		CLAY, very stiff, brown to dark brown. (CH)	100	32	SPLIT SPOON -45.4	8 10 14	47.5
			Clayey SAND, little silt, little gravel, very stiff, brown to dark brown; gravel consists of weathered rock fragments. (SC)	100	33	SPLIT SPOON -46.9	10 12 15	
			-as above.	100	34	SPLIT SPOON	8	50
						(continued)		

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 2.594 Ft.

PROJECT: Martin Pena Project, San Juan, P.R.

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-47.4	50.0						
-48.4	51.0			100	34	SPLIT SPOON -48.4	8 / 11

END OF BORING CB-MP98-06 AT 51.0 FEET DEPTH.

NOTES:

Soils are field visually classified in accordance with the Unified Soils Classification System.

140# Hammer with 30" drop used on 2.0 foot split spoon (1-3/8" I.D. x 2" O.D.)

P=sampler was pushed into the ground only by the weight of the hammer.

Sample No.	Moisture Content%	Spec. Gravity	Att. Limits L.L.	P.I.
5	457.1	1.40	--	--
9	20.9	1.57	35.0	18.5
17	23.3	2.77	89.0	60.8
22	34.1	2.74	98.0	64.5
25	34.1	2.78	93.0	63.9
30	37.7	2.62	78.0	51.4
33	31.5	2.98	--	--

-50 -52.5 -55 -57.5 -60 -62.5 -65 -67.5 -70 -72.5 -75 -77.5

DRILLING LOG

DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 3
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=630,865 Y=217,860	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: CME-55
4. HOLE NO. (As shown on drawing title and file number): CB-MP98-07	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 34 undisturbed: 0
5. NAME OF DRILLER: CARLOS CALDERON	14. TOTAL NUMBER OF CORE BOXES: 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: 1.048 Ft.
	16. DATE HOLE: STARTED 05/05/98 COMPLETED 05/05/98
	17. ELEVATION TOP OF HOLE: 3.548 Ft.
7. THICKNESS OF BURDEN: 51.0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 79.1% %
8. DEPTH DRILLED INTO ROCK: 0 Ft.	19. SIGNATURE OF ENGINEER: Jorge R. Parra, P.E. JRP
9. TOTAL DEPTH OF HOLE: 51.0 Ft.	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
3.5	.0					3.5	
			FILL consisting of silty GRAVEL with little sand, very dense, brown, gravel consist of construction debris. (GM) └ trace silt.	88.9	1	SPLIT SPOON 2.0	15 / 33 / 42
				66.7	2	SPLIT SPOON .5	40 / 20 / 22
-1.0	4.5		-loose, some organic silt.	44.4	3	SPLIT SPOON -1.0	3 / 2 / 3
			FILL-Wood fragments with construction debris in a sandy silt, dark gray matrix.	27.8	4	SPLIT SPOON -2.5	3 / 1 / 1
			-some black organic clay.	16.7	5	SPLIT SPOON -4.0	3 / 2 / 1
			-no recovery.	0	6	SPLIT SPOON -5.5	4 / 3 / 4
			-no recovery.	0	7	SPLIT SPOON -7.0	1 / P / 1
-8.5	12.0		Organic CLAY with some clayey sand, some trash consisting of rubber and plastics, soft, black.	83.3	8	SPLIT SPOON -8.5	1 / 2 / 2
			CLAY with some sand, stiff, dark gray, little trash (rubber). (CH)	66.7	9	SPLIT SPOON -10.0	P / 4 / 5
-11.5	15.0		-as above, gray.	66.7	10	SPLIT SPOON -11.5	2 / 4 / 6
			Sandy CLAY, sand is fine-grained, trace silt, very stiff, light gray, dark yellowish brown. (CL)	100	11	SPLIT SPOON -13.0	10 / 11 / 13
			└ -stiff.	77.8	12	SPLIT SPOON -14.5	6 / 6 / 8
			-very stiff, trace sand.	100	13	SPLIT SPOON -16.0	6 / 8 / 10
-17.5	21.0			100	14	SPLIT SPOON -17.5	3 / 5 / 5
			CLAY, trace sand, very stiff, dark yellowish brown, gray mottled. (CH)	88.7	15	SPLIT SPOON -19.0	4 / 10 / 10
						(continued)	

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.CB-MP98-07

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 3.548 Ft.

SHEET 2 OF 3

PROJECT: Martin Pena Project, San Juan, P.R.

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
-19.0	22.5					-19.0	
				100	16	SPLIT SPOON -20.5	6, 10, 13
			-as above.	100	17	SPLIT SPOON -22.0	6, 13, 14
			-trace sand. (CH)	100	18	SPLIT SPOON -23.5	10, 14, 16
			-dark yellowish to reddish brown.	100	19	SPLIT SPOON -25.0	8, 14, 14
				94.4	20	SPLIT SPOON -26.5	9, 10, 14
				38.9	21	SPLIT SPOON -28.0	3, 4, 10
				100	22	SPLIT SPOON -29.5	10, 15, 17
				88.9	23	SPLIT SPOON -31.0	9, 11, 16
				100	24	SPLIT SPOON -32.5	8, 10, 13
			-hard, trace sand. (CH)	100	25	SPLIT SPOON -34.0	11, 16, 16
				100	26	SPLIT SPOON -35.5	6, 11, 17
				100	27	SPLIT SPOON -37.0	10, 14, 19
				100	28	SPLIT SPOON -38.5	9, 13, 16
				100	29	SPLIT SPOON -40.0	9, 14, 20
			-trace gravel and silt.	100	30	SPLIT SPOON -41.5	7, 12, 13
			-as above.	94.4	31	SPLIT SPOON -43.0	8, 10, 9
			-no gravel.	100	32	SPLIT SPOON -44.5	8, 15, 31
				50	33	SPLIT SPOON -46.0	10, 10, 12
				94.4	34	SPLIT SPOON	9
						(continued)	

Depth scale: 22.5, 25, 27.5, 30, 32.5, 35, 37.5, 40, 42.5, 45, 47.5, 50

Hole No.CB-MP98-07

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE	SHEET 3 OF 3
3.548 Ft.	

PROJECT: Martin Pena Project, San Juan, P.R.

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-46.5	50.0						
				94.4	34	SPLIT SPOON	15
-47.5	51.0					-47.5	17

END OF BORING CB-MP98-07 AT 51.0 FEET DEPTH.

NOTES:

Soils are field visually classified in accordance with the Unified Soils Classification System.

140# Hammer with 30" drop used on 2.0 foot split spoon (1-3/8" I.D. x 2" O.D.)

P=sampler was pushed into the ground only by the weight of the hammer.

Sample No.	Moisture Content%	Spec. Grav.	Att. Limits L.L%	P.I%
9	40.4	--	--	--
12	24.0	2.66	46.2	26.1
17	35.6	--	--	--
19	34.2	2.73	91.0	60.6
23	33.4	--	--	--
25	36.4	2.83	97.0	65.0
28	34.9	--	--	--

50 52.5 55 57.5 60 62.5 65 67.5 70 72.5 75 77.5

Hole No. CB-MP98-08

DRILLING LOG

DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 3
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=631,245 Y=217,771	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: CME-55
4. HOLE NO. (As shown on drawing title and file number): CB-MP98-08	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 34 undisturbed: 0
5. NAME OF DRILLER: CARLOS CALDERON	14. TOTAL NUMBER OF CORE BOXES: 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: -1.2 Ft.
	16. DATE HOLE: STARTED 05/04/98 COMPLETED 05/04/98
7. THICKNESS OF BURDEN: 51.0 Ft.	17. ELEVATION TOP OF HOLE: 3.30 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 88.9 %
9. TOTAL DEPTH OF HOLE: 51.0 Ft.	19. SIGNATURE OF ENGINEER: Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
3.3	.0					3.3	
			-No recovery	0	1	SPLIT SPOON; 1.8	3, 5, 5
.3	3.0		FILL-Sand-gravel and clay, trace roots, trace brick and asphalt fragments, dark brown, red, black. (SC)	33.3	2	SPLIT SPOON; .3	6, 7, 12
			FILL-soft, sticky clay with trash (glass, wood and porcelain), yellowish brown and black. (CH)	16.7	3	SPLIT SPOON; -1.2	3, 2, 5
-2.7	6.0		-as above, trace organic peat.	55.6	4	SPLIT SPOON; -2.7	2, 1, 1
-4.2	7.5		Organic SILT to silty CLAY, very soft, little black peat, olive brown. (OL)	88.9	5	SPLIT SPOON; -4.2	1, 7, 8
-5.7	9.0		SAND, fine-grained, medium dense, light brown. (SP)	83.3	6	SPLIT SPOON; -5.7	5, 5, 7
			Sandy CLAY, medium stiff, olive and brown. (CL)	94.4	7	SPLIT SPOON; -7.2	3, 2, 3
-8.7	12.0		-as above.	100	8	SPLIT SPOON; -8.7	7, 7, 11
			CLAY, trace sand, medium stiff, light gray to grayish brown. (CH)	100	9	SPLIT SPOON; -10.2	2, 3, 3
			-as above, very stiff.	88.9	10	SPLIT SPOON; -11.7	4, 9, 13
			-little sand	94.4	11	SPLIT SPOON; -13.2	3, 6, 12
				100	12	SPLIT SPOON; -14.7	3, 7, 8
				100	13	SPLIT SPOON; -16.2	6, 10, 15
				100	14	SPLIT SPOON; -17.7	4, 8, 14
				100	15	SPLIT SPOON; -19.2	8, 10, 17

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

(continued)

Hole No.CB-MP98-08

DRILLING LOG (Cont. Sheet) | ELEVATION TOP OF HOLE: 3.30 Ft. | SHEET 2 OF 3

PROJECT: Martin Pena Project, San Juan, P.R. | INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
-19.2	22.5		~~-dark yellowish brown and light~~ gray.			-19.2	
				100	16	SPLIT SPOON -20.7	7, 12, 17
			-hard.	100	17	SPLIT SPOON -22.2	6, 10, 12
			-trace sand.	100	18	SPLIT SPOON -23.7	8, 13, 17
				100	19	SPLIT SPOON -25.2	4, 12, 16
			-dark brown.	100	20	SPLIT SPOON -26.7	9, 16, 22
-28.2	31.5			100	21	SPLIT SPOON -28.2	7, 13, 19
			High plasticity SILT, trace sand, hard, drk yellowish brown, red mottled. (MH)	100	22	SPLIT SPOON -29.7	12, 18, 26
-31.2	34.5			100	23	SPLIT SPOON -31.2	14, 24, 24
-32.7	36.0		-intermixed sand lens. (ML)	100	24	SPLIT SPOON -32.7	7, 14, 16
			CLAY, hard, dark yellowish brown to reddish brown, light gray mottled. (CH)	100	25	SPLIT SPOON -34.2	11, 18, 29
			-dark brown to reddish brown.	100	26	SPLIT SPOON -35.7	12, 21, 29
				100	27	SPLIT SPOON -37.2	12, 18, 23
				100	28	SPLIT SPOON -38.7	11, 21, 25
				88.9	29	SPLIT SPOON -40.2	12, 20, 28
			-stiff, very wet.	100	30	SPLIT SPOON -41.7	13, 21, 29
			-hard.	77.8	31	SPLIT SPOON -43.2	6, 10, 16
				100	32	SPLIT SPOON -44.7	13, 23, 31
				100	33	SPLIT SPOON -46.2	12, 21, 34
				100	34	SPLIT SPOON	13
						(continued)	

Depth scale: 22.5, 25, 27.5, 30, 32.5, 35, 37.5, 40, 42.5, 45, 47.5, 50

Hole No.CB-MP98-08

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 3.30 Ft.

SHEET 3 OF 3

PROJECT: Martin Pena Project, San Juan, P.R.

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-46.7	50.0						
-47.7	51.0			100	34	SPLIT SPOON -47.7	27 / 31
			END OF BORING CB-MP98-08 AT 51.0 FEET DEPTH. NOTES: Soils are field visually classified in accordance with the Unified Soils Classification System. 140# Hammer with 30" drop used on 2.0 foot split spoon (1-3/8" I.D. x 2" O.D.)				

Sample No.	Moisture Content%	Spec. Grav.	Att. Limits L.L%	P.I%
7	21.5	--	--	--
10	40.6	2.65	--	--
11	29.5	--	72	39.7
19	41.9	2.82	101.5	67
22	35.4	2.78	82.9	39.4
28	35.2	--	--	--
32	35.2	--	--	--

-50 -52.5 -55 -57.5 -60 -62.5 -65 -67.5 -70 -72.5 -75 -77.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Martin Pena Project, San Juan, P.R.

HOLE NUMBER: CB-MP98-08

Hole No.CB-MP98-09

DRILLING LOG

DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 3
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=631,380 Y=218,340	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: CME-55
4. HOLE NO. (As shown on drawing title and file number): CB-MP98-09	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 34 undisturbed: 0
5. NAME OF DRILLER: JUAN A. CALDERON	14. TOTAL NUMBER OF CORE BOXES: 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: 0.084 Ft.
	16. DATE HOLE: STARTED 05/26/98 COMPLETED 05/26/98
7. THICKNESS OF BURDEN: 51.0 Ft.	17. ELEVATION TOP OF HOLE: 2.084 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 89.4 %
9. TOTAL DEPTH OF HOLE: 51.0 Ft.	19. SIGNATURE OF ENGINEER: Jorge R. Parra, P.E.

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
2.1	.0				2.1	
		FILL - CLAY, some sand, trace gravel, trace decomposed wood fragments, trace concrete fragments, little garbage (plastics), stiff, dark brown and black.	88.9	1	SPLIT SPOON .6	4 5 7
		FILL - sampled as soft sandy gravelly-silt, dark olive gray, black.	22.2	2	SPLIT SPOON -.9	3 2 4
		FILL - decomposed tree trunk, brown.	44.4	3	SPLIT SPOON -2.4	6 6 7
-3.9	6.0	FILL - Wood fragments in an organic soft soil-sandy silt matrix, dark gray and black.	83.3	4	SPLIT SPOON -3.9	1 1 2
-5.4	7.5	Organic Sandy SILT, soft, very dark gray. (OL)	27.8	5	SPLIT SPOON -5.4	2 1 2
-6.9	9.0	Organic SILT, little sand, very soft, very dark gray. (OL)	61.1	6	SPLIT SPOON -6.9	2 2 1
-8.4	10.5	Silty SAND, very loose, brown. (SM)	72.2	7	SPLIT SPOON -8.4	P P 1
		Low Plasticity CLAY, trace sand, very stiff, light gray. (CL)	83.3	8	SPLIT SPOON -9.9	3 5 7
		-as above	83.3	9	SPLIT SPOON -11.4	5 5 7
			100	10	SPLIT SPOON -12.9	5 8 11
			100	11	SPLIT SPOON -14.4	4 6 9
		-light gray and dark brown	100	12	SPLIT SPOON -15.9	6 7 7
		-dark brown, little silt	100	13	SPLIT SPOON -17.4	8 10 13
		-as above	100	14	SPLIT SPOON -18.9	6 8 12
			100	15	SPLIT SPOON -20.4	8 15 13
					(continued)	

Hole No.CB-MP98-09

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 2.084 Ft.

SHEET 2 OF 3

PROJECT: Martin Pena Project, San Juan, P.R.

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
-20.4	22.5					-20.4	
			Low Plasticity CLAY, very stiff, reddish brown to brownish red. (CL) -as above	100	16	SPLIT SPOON -21.9	9 11 14
				100	17	SPLIT SPOON -23.4	7 15 21
			-hard	100	18	SPLIT SPOON -24.9	11 18 22
-26.4	28.5			100	19	SPLIT SPOON -26.4	9 15 21
			High Plasticity CLAY, hard, red to brownish red. (CH)	100	20	SPLIT SPOON -27.9	9 13 20
				100	21	SPLIT SPOON -29.4	12 15 27
				100	22	SPLIT SPOON -30.9	9 17 21
				100	23	SPLIT SPOON -32.4	6 15 19
				100	24	SPLIT SPOON -33.9	5 17 25
				72.5	25	SPLIT SPOON -35.4	7 13 18
				100	26	SPLIT SPOON -36.9	10 14 14
				100	27	SPLIT SPOON -38.4	9 17 23
				100	28	SPLIT SPOON -39.9	8 15 19
				100	29	SPLIT SPOON -41.4	9 14 18
				100	30	SPLIT SPOON -42.9	7 12 17
				100	31	SPLIT SPOON -44.4	6 11 15
-45.9	48.0			100	32	SPLIT SPOON -45.9	8 13 14
-47.4	49.5		-sandy (CL)	100	33	SPLIT SPOON -47.4	10 15 19
			-no sand	100	34	SPLIT SPOON	9
						(continued)	

Depth scale: 22.5, 25, 27.5, 30, 32.5, 35, 37.5, 40, 42.5, 45, 47.5, 50

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Martin Pena Project, San Juan, P.R. | HOLE NUMBER: CB-MP98-09

Hole No.CB-MP98-09

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE	SHEET 3 OF 3
2.084 Ft.	

PROJECT	INSTALLATION
Martin Pena Project, San Juan, P.R.	Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-47.9	50.0						
-48.9	51.0			100	34	-48.9 SPLIT SPOON	13 / 17

END OF BORING CB-MP98-09 AT 51.0 FEET DEPTH.

NOTES:

Soils are field visually classified in accordance with the Unified Soils Classification System.

140# Hammer with 30" drop used on 2.0 foot split spoon (1-3/8" I.D. x 2" O.D.)

P=sampler was pushed into the ground only by the weight of the hammer.

Sample No.	Moisture Content%	Spec. Grav.	Att. Limits L.L%	P.I%
9	19.2	--	42.5	26.2
16	29.5	--	47.0	21.7
26	34.7	--	91.5	59.1

-50 -52.5 -55 -57.5 -60 -62.5 -65 -67.5 -70 -72.5 -75 -77.5

Hole No.CB-MP98-10

DRILLING LOG

DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 3
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=631,543 Y=218,107	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: CME-55
4. HOLE NO. (As shown on drawing title and file number): CB-MP98-10	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 34 undisturbed: 0
5. NAME OF DRILLER: CARLOS CALDERON	14. TOTAL NUMBER OF CORE BOXES: 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: -0.706 ft.
	16. DATE HOLE: STARTED 05/13/98 COMPLETED 05/13/98
7. THICKNESS OF BURDEN: 51.0 Ft.	17. ELEVATION TOP OF HOLE: 2.294 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 84.2 %
9. TOTAL DEPTH OF HOLE: 51.0 Ft.	19. SIGNATURE OF ENGINEER: JORGE R. PARRA, P.E. JRP

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
2.3	.0					2.3	
.8	1.5		FILL consisting of CLAY with some gravel and little sand, very stiff, brown.. (CH)	77.8	1	SPLIT SPOON .8	12 / 8 / 7
-.7	3.0		SAND, some gravel, red, olive, well graded, green to brown; some trade consisting of plastics and cristals fragments. (SW)	88.9	2	SPLIT SPOON -.7	9 / 15 / 6
-2.2	4.5		CLAY, some gravel, very soft, brown. (CH)	16.7	3	SPLIT SPOON -2.2	3 / 1 / 1
			Peat, little organic clay, very soft, fibrous, black, strong organic odor. (Pt)	44.4	4	SPLIT SPOON -3.7	P / 1 / 1
			-as above	55.6	5	SPLIT SPOON -5.2	P / P / 1
			-as above	22.2	6	SPLIT SPOON -6.7	P / P / P
-8.2	10.5		-as above	77.8	7	SPLIT SPOON -8.2	1 / P / P
			CLAY, little sand, very soft, gray to dark brown, some decomposing plant fragments. (CH)	100	8	SPLIT SPOON -9.7	1 / 1 / 1
-11.2	13.5		-medium stiff	66.7	9	SPLIT SPOON -11.2	2 / 3 / 4
			CLAY, little to trace quartz sand, very stiff, gray. (CH)	77.8	10	SPLIT SPOON -12.7	4 / 6 / 10
-14.2	16.5		-as above	88.9	11	SPLIT SPOON -14.2	4 / 6 / 9
-15.7	18.0		-some sand, low plasticity clay. (CL)	100	12	SPLIT SPOON -15.7	4 / 7 / 9
			-some silt	88.9	13	SPLIT SPOON -17.2	6 / 8 / 10
			-little quartz sand	66.7	14	SPLIT SPOON -18.7	5 / 10 / 12
			-gray to olive green	100	15	SPLIT SPOON -20.2	5 / 10 / 15
						(continued)	

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71

Hole No.CB-MP98-10

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 3.528 Ft.

SHEET 2 OF 3

PROJECT: Martin Pena Project, San Juan, P.R.

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-19.0	22.5					-19.0	
			-trace silt and sand	77.8	16	SPLIT SPOON	5
							6
-20.5	24.0					-20.5	9
			Silty Clay with trace quartz sand, very stiff, dark red. (CL)	100	17	SPLIT SPOON	5
							7
-22.0	25.5					-22.0	8
			SILT, little clay and trace gravel, hard, brown to dark red. (ML)	100	18	SPLIT SPOON	10
							15
-23.5	27.0					-23.5	21
			CLAY, little silt, very stiff, brown to dark red to gray. (CH)	38.9	19	SPLIT SPOON	5
							8
						-25.0	10
			-as above	100	20	SPLIT SPOON	8
							11
						-26.5	16
			-gray, trace silt	100	21	SPLIT SPOON	6
							10
-28.0	31.5					-28.0	12
			CLAY, some quartz sand, very stiff, gray. (CL)	100	22	SPLIT SPOON	8
							12
						-29.5	14
			-as above, low plasticity.	100	23	SPLIT SPOON	9
							12
						-31.0	13
			-little sand	94.4	24	SPLIT SPOON	5
							9
						-32.5	17
			-pale brown	100	25	SPLIT SPOON	8
							12
						-34.0	15
			-some quartz sand, hard	100	26	SPLIT SPOON	9
							15
						-35.5	15
			-some to little quartz sand	94.4	27	SPLIT SPOON	10
							15
-37.0	40.5					-37.0	16
			High plasticity CLAY, very stiff, pale brown. (CH)	94.4	28	SPLIT SPOON	8
							12
						-38.5	14
			-as above	88.9	29	SPLIT SPOON	9
							12
						-40.0	15
			-high plasticity	100	30	SPLIT SPOON	9
							12
						-41.5	11
				100	31	SPLIT SPOON	6
							7
						-43.0	17
				100	32	SPLIT SPOON	9
							12
						-44.5	16
				100	33	SPLIT SPOON	9
							14
						-46.0	14
				100	34	SPLIT SPOON	6
						(continued)	

Depth scale: 22.5, 25, 27.5, 30, 32.5, 35, 37.5, 40, 42.5, 45, 47.5, 50

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 3.528 Ft.

SHEET 3 OF 3

PROJECT: Martin Pena Project, San Juan, P.R.

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
-46.5	50.0						
-47.5	51.0			100	34	SPLIT SPOON -47.5	9 12
			END OF BORING CB-MP98-10 AT 51.0 FEET DEPTH.				

NOTES:

Soils are field visually classified in accordance with the Unified Soils Classification System.

140# Hammer with 30" drop used on 2.0 foot split spoon (1-3/8" I.D. x 2" O.D.)

P=sampler was pushed into the ground only by the weight of the hammer.

Sample No.	Moisture Content%	Spec. Gravity	Att. Limits L.L.	P.I.
5	233	2.04	--	--
8	53.1	--	--	--
9	34.9	--	--	--
11	27.0	2.65	--	--
12	26.9	--	46.8	27.4
23	22.4	2.59	36.6	20.7
30	29.6	2.79	66.0	39.8

Sample No.	Organic Content
5	54.29%

-50 -52.5 -55 -57.5 -60 -62.5 -65 -67.5 -70 -72.5 -75 -77.5

DRILLING LOG

DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 3
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=631,864 Y=218,574	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: CME-55
4. HOLE NO. (As shown on drawing title and file number): CB-MP98-11	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 31 undisturbed: 0
5. NAME OF DRILLER: CARLOS CALDERON	14. TOTAL NUMBER OF CORE BOXES: 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: 0.045 ft.
	16. DATE HOLE: STARTED 05/26/98 COMPLETED 05/26/98
7. THICKNESS OF BURDEN: 46.5 Ft.	17. ELEVATION TOP OF HOLE: 1.545 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 71.1 %
9. TOTAL DEPTH OF HOLE: 46.5 Ft.	19. SIGNATURE OF ENGINEER: JORGE R. PARRA, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
1.5	.0					1.5	
			FILL consisting of Silty SAND with some gravel, meidium dense, well graded, brown to dark brown. (SM)	66.7	1	SPLIT SPOON .0	9, 4, 2
.0	1.5		FILL-Organic CLAY with some trash and plant fragments, soft, black; trash consists of plastic and wood fragments. (OH)	27.8	2	SPLIT SPOON -1.5	1, 2, 2
			-no recovery.	0	3	SPLIT SPOON -3.0	1, 1, 2
			-no recovery.	0	4	SPLIT SPOON -4.5	1, 1, 2
-4.5	6.0		PEAT with decomposed wood fragments, very soft, fibrous, black. (Pt)	100	5	SPLIT SPOON -6.0	1, 1, 1
-6.0	7.5		CLAY, trace peat and quartz sand, very soft, brown to black, some plant fragments. (CH)	100	6	SPLIT SPOON -7.5	P, P, P
			-gray to black.	100	7	SPLIT SPOON -9.0	P, P, 2
-9.0	10.5		Low plasticity CLAY, medium stiff, some quartz sand, brown. (CL)	100	8	SPLIT SPOON -10.5	1, 2, 3
			-gray to brown, little quartz sand.	100	9	SPLIT SPOON -12.0	2, 3, 3
			-pale brown, little to some quartz sand, trace plant fragments, very stiff.	100	10	SPLIT SPOON -13.5	4, 5, 11
			-medium stiff.	100	11	SPLIT SPOON -15.0	P, 2, 3
			-very stiff, brown to reddish brown to red.	100	12	SPLIT SPOON -16.5	5, 10, 10
-16.5	18.0		Silty CLAY, little quartz sand, stiff, brown. (CL-ML)	100	13	SPLIT SPOON -18.0	4, 6, 7
-18.0	19.5		Clayey SILT, little quartz sand, very stiff, brown to reddish brown to gray. (ML)	100	14	SPLIT SPOON -19.5	5, 7, 8
-19.5	21.0		Sandy CLAY, very stiff, brown to reddish brown to gray. (CL)	100	15	SPLIT SPOON -21.0	5, 10, 12
						(continued)	

Hole No.CB-MP98-11

DRILLING LOG (Cont. Sheet) | ELEVATION TOP OF HOLE 1.545 Ft. | SHEET 2 OF 3

PROJECT Martin Pena Project, San Juan, P.R. | INSTALLATION Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
-21.0	22.5					-21.0	
			-trace oxide nodules, no gray. -hard.	100	16	SPLIT SPOON -22.5	5 10 12
-24.0	25.5			100	17	SPLIT SPOON -24.0	7 14 16
			High Plasticity CLAY, trace quartz sand, very stiff, brown. (CH) -gray to brown.	38.9	18	SPLIT SPOON -25.5	5 7 9
			-hard, brown to reddish brown.	66.7	19	SPLIT SPOON -27.0	4 6 10
			-as above.	77.8	20	SPLIT SPOON -28.5	6 16 19
			-as above.	77.8	21	SPLIT SPOON -30.0	7 14 22
			-no quartz sand.	55.6	22	SPLIT SPOON -31.5	7 14 21
-33.0	34.5			77.8	23	SPLIT SPOON -33.0	17 22 23
			Sandy CLAY, hard, brown to reddish brown; (sand consists of medium quartz sand). (CL) -trace quartz, sand.	100	24	SPLIT SPOON -34.5	12 22 40
-36.0	37.5			100	25	SPLIT SPOON -36.0	17 26 22
			CLAY, hard, brown to reddish brown. (CH) -no recovery.	100	26	SPLIT SPOON -37.5	17 27 28
-39.0	40.5			0	27	SPLIT SPOON -39.0	17 25 25
			High Plasticity CLAY, hard, brown. (CH) -as above.	77.8	28	SPLIT SPOON -40.5	12 14 22
			-as above.	100	29	SPLIT SPOON -42.0	13 20 27
			-very stiff.	94.4	30	SPLIT SPOON -43.5	16 22 24
-45.0	46.5			55.6	31	SPLIT SPOON -45.0	4 9 11
			END OF BORING CB-MP98-11 AT 46.5 FEET DEPTH. NOTES: 1) Soils are field visually classified in accordance with the Unified Soils Classification System.				
						(continued)	

Depth scale: 22.5, 25, 27.5, 30, 32.5, 35, 37.5, 40, 42.5, 45, 47.5, 50

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE	SHEET 3 OF 3
1.545 Ft.	

PROJECT	INSTALLATION
Martin Pena Project, San Juan, P.R.	Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-48.5	50.0						

2) 140# Hammer with 30" drop used on 2.0 foot split spoon (1-3/8" I.D. x 2" O.D.)

3) P= sampler was pushed into the ground only by the weight of the hammer.

4) Boring CB-MP98-11 was stopped at a depth of 46.5 for security reasons.

Sample No.	Moisture Content%	Spec. Gravity	Att. Limits L.L.	P.I.
8	27.0	2.76	49.0	28.9
15	25.9	2.69	48.0	28.8
19	40.8	2.71	108.0	74.8
21	33.7	2.78	92.5	62.0
24	37.4	--	--	--
29	39.21	2.83	91.0	58.1

-50 -52.5 -55 -57.5 -60 -62.5 -65 -67.5 -70 -72.5 -75 -77.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT	HOLE NUMBER
Martin Pena Project, San Juan, P.R.	CB-MP98-11

Hole No.CB-MP98-12

DRILLING LOG DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 3
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=632,300 Y=218,009	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: CME-55
4. HOLE NO. (As shown on drawing title and file number): CB-MP98-12	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 34 undisturbed: 0
5. NAME OF DRILLER: CARLOS CALDERON	14. TOTAL NUMBER OF CORE BOXES: 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: −0.916 ft.
	16. DATE HOLE: STARTED 05/06/98 COMPLETED 05/06/98
7. THICKNESS OF BURDEN: 51.0 Ft.	17. ELEVATION TOP OF HOLE: 2.008 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 95 %
9. TOTAL DEPTH OF HOLE: 51.0 Ft.	19. SIGNATURE OF ENGINEER: JORGE R. PARRA, P.E. JRP

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
2.0	.0					2.0	
			FILL consisting of gravelly CLAY, stiff, brown. (CL)	88.9	1	SPLIT SPOON .5	10 4 5
			-no recovery.	0	2	SPLIT SPOON −1.0	4 3 3
−2.5	4.5		-gray to brown.	22.2	3	SPLIT SPOON −2.5	2 3 5
			FILL-GRAVEL, trace clay, well graded, medium dense, black, gravel consists of concrete fragments.	16.9	4	SPLIT SPOON −4.0	5 5 2
−5.5	7.5		-some root and trash fragments, loose.	22.2	5	SPLIT SPOON −5.5	12 2 2
			PEAT with some organic clay and little shell fragments, very soft, fibrous, black. (Pt)	100	6	SPLIT SPOON −7.0	P P P
			-as above.	94.4	7	SPLIT SPOON −8.5	P P P
−10.0	12.0		-as above.	100	8	SPLIT SPOON −10.0	1 1 P
			Sandy SILT, very soft, olive-gray. (ML)	100	9	SPLIT SPOON −11.5	P P P
			-little organic clay.	100	10	SPLIT SPOON −13.0	P P P
−14.5	16.5		-stiff, some clay.	100	11	SPLIT SPOON −14.5	2 4 5
			CLAY, little sand, stiff, gray to green. (CH)	100	12	SPLIT SPOON −16.0	5 5 7
−17.5	19.5		-as above.	100	13	SPLIT SPOON −17.5	3 4 4
−19.0	21.0		Silty CLAY, soft, brown. (CH)	77.8	14	SPLIT SPOON −19.0	P P 4
			CLAY, little silt and trace sand, stiff, brown to gray. (CH)	100	15	SPLIT SPOON −20.5	5 6 8
						(continued)	

Scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.CB-MP98-13

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 3

1. PROJECT Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT See Remarks
2. LOCATION (Coordinates or Station) X=632,526 Y=218,153	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL CME-55
4. HOLE NO. (As shown on drawing title and file number) CB-MP98-13	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 34 undisturbed: 0
5. NAME OF DRILLER JOSE AYALA	14. TOTAL NUMBER OF CORE BOXES 1
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER 0.62 ft.
	16. DATE HOLE STARTED 05/27/98 COMPLETED 05/27/98
7. THICKNESS OF BURDEN 51.0 Ft.	17. ELEVATION TOP OF HOLE 2.120 Ft.
8. DEPTH DRILLED INTO ROCK 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING 80.7 %
9. TOTAL DEPTH OF HOLE 51.0 Ft.	19. SIGNATURE OF ENGINEER JORGE R. PARRA, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
2.1	.0					2.1	
			FILL consisting of Quartz SANd with little silt, poorly graded, medium dense, subangular, dark brown. (SP)	77.8	1	SPLIT SPOON .6	5 / 10 / 7
			-some gravel sized concrete fragments	44.4	2	SPLIT SPOON -.9	11 / 7 / 8
-.9	3.0		FILL - CLAY, little gravel, little sand, some trash and wood fragments, stiff, dark brown. (CL)	44.4	3	SPLIT SPOON -2.4	4 / 6 / 6
-2.4	4.5		SAND, trace silt, loose, well graded, dark brown. (SW)	11.1	4	SPLIT SPOON -3.9	3 / 3 / 2
-3.9	6.0		Organic CLAY with litte peat, very soft, black; strong organic odor. (OH)	77.8	5	SPLIT SPOON -5.4	P / P / P
			-as above	77.8	6	SPLIT SPOON -6.9	P / P / P
-7.0	9.1		Peat with some little organic clay, fibrous, very soft, black; little shell fragments. (Pt)	66.7	7	SPLIT SPOON -8.4	P / P / P
			-dark brown to black	83.3	8	SPLIT SPOON -9.9	P / P / P
			-as above	94.4	9	SPLIT SPOON -11.4	P / P / P
-11.4	13.5		CLAY, some peat and trace quartz sand, very soft, gray to black. (OH)	77.8	10	SPLIT SPOON -12.9	P / P / 1
			-no peat, gray to black	66.7	11	SPLIT SPOON -14.4	P / P / P
-14.4	16.5		CLAY, soft to medium, little quartz sand, gray to black, slight organic odor. (CH)	100	12	SPLIT SPOON -15.9	3 / 3 / 5
				55.6	13	SPLIT SPOON -17.4	1 / 2 / 4
-17.4	19.5		Low Plasticity CLAY, stiff, gray. (CL)	83.3	14	SPLIT SPOON -18.9	4 / 5 / 5
			-trace silt, olive green	100	15	SPLIT SPOON -20.4	3 / 5 / 5
						(continued)	

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.CB-MP98-13

DRILLING LOG (Cont. Sheet) | ELEVATION TOP OF HOLE 2.120 Ft. | SHEET 2 OF 3

PROJECT: Martin Pena Project, San Juan, P.R. | INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
-20.4	22.5					-20.4	
			-little silt, green olive-brown-gray -pale brown	100	16	SPLIT SPOON -21.9	4 6 6
				83.3	17	SPLIT SPOON -23.4	2 4 5
			-very stiff, brown to gray	100	18	SPLIT SPOON -24.9	5 7 11
			-as above	55.6	19	SPLIT SPOON -26.4	3 6 11
			-trace silt	88.9	20	SPLIT SPOON -27.9	9 13 14
			-as above	38.9	21	SPLIT SPOON -29.4	5 6 11
			-brown to reddish brown	100	22	SPLIT SPOON -30.9	7 13 15
			-as above	100	23	SPLIT SPOON -32.4	5 7 11
			-trace quartz sand	100	24	SPLIT SPOON -33.9	9 13 10
			-little quartz sand	100	25	SPLIT SPOON -35.4	4 4 9
			-little to some quartz sand	50	26	SPLIT SPOON -36.9	5 12 14
-38.4	40.5		-some quartz sand and trace oxide nodules	66.7	27	SPLIT SPOON -38.4	4 7 14
			Sandy CLAY, very stiff, brown reddish brown (sand portion consists of fine quartz sand). (CL)	100	28	SPLIT SPOON -39.9	8 12 12
			-some quartz sand, hard	100	29	SPLIT SPOON -41.4	12 22 31
			-trace oxide nodules	100	30	SPLIT SPOON -42.9	15 18 15
			-very stiff, little oxide nodules, trace gravel	100	31	SPLIT SPOON -44.4	10 12 12
			-reddish brown	100	32	SPLIT SPOON -45.9	5 10 11
			-as above	100	33	SPLIT SPOON -47.4	7 9 11
			-hard, some oxide nodules	100	34	SPLIT SPOON	10
						(continued)	

Depth scale: 22.5, 25, 27.5, 30, 32.5, 35, 37.5, 40, 42.5, 45, 47.5, 50

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Martin Pena Project, San Juan, P.R. | HOLE NUMBER: CB-MP98-13

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE	SHEET 3 OF 3
2.120 Ft.	

PROJECT	INSTALLATION
Martin Pena Project, San Juan, P.R.	Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-47.9	50.0						
				100	34	SPLIT SPOON -48.9	22 / 24
-48.9	51.0		END OF BORING CB-MP98-13 AT 51.0 FEET DEPTH.				

NOTES:

Soils are field visually classified in accordance with the Unified Soils Classification System.

140# Hammer with 30" drop used on 2.0 foot split spoon (1-3/8" I.D. x 2" O.D.)

P=sampler was pushed into the ground only by the weight of the hammer.

Sample No.	Moisture Content%	Spec. Gravity	Att. Limits L.L.	P.I.
8	308	1.75	--	--
14	33.5	--	48.5	22.8
23	29.6	--	47.0	22.6

Sample No.	Organic Content
8	60.82%

-50 -52.5 -55 -57.5 -60 -62.5 -65 -67.5 -70 -72.5 -75 -77.5

Hole No.CB-MP98-14

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 3

1. PROJECT Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT See Remarks
2. LOCATION (Coordinates or Station) X=633,282 Y=217,755	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL CME-55
4. HOLE NO. (As shown on drawing title and file number) CB-MP98-14	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 34 undisturbed: 0
5. NAME OF DRILLER JOSE AYALA	14. TOTAL NUMBER OF CORE BOXES 1
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER 1.122 ft.
	16. DATE HOLE STARTED 05/28/98 COMPLETED 05/28/98
7. THICKNESS OF BURDEN 51.0 Ft.	17. ELEVATION TOP OF HOLE 2.622 Ft.
8. DEPTH DRILLED INTO ROCK 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING 92.7 %
9. TOTAL DEPTH OF HOLE 51.0 Ft.	19. SIGNATURE OF ENGINEER JORGE R. PARRA, P.E. JRP.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
2.6	.0					2.6	
			FILL consisting of Gravelly CLAY, some silt and sand, very stiff, brown. (CL)	77.8	1	SPLIT SPOON 1.1	10 9 6
			FILL consisting of Sandy CLAY, some gravel, medium stiff, brown. (CL) -very soft	66.7	2	SPLIT SPOON -.4	9 4 2
-1.9	4.5			33.3	3	SPLIT SPOON -1.9	2 1 1
-3.4	6.0		SAND, little silt, loose, well graded, black. (SW)	55.6	4	SPLIT SPOON -3.4	4 5 4
			PEAT, some sand, and little gravel, soft, fibrous, black. (Pt)	77.8	5	SPLIT SPOON -4.9	11 2 1
			-sand and gravel, little shell fragments, very soft	77.8	6	SPLIT SPOON -6.4	1 1 1
			-little organic clay with trace sand	94.4	7	SPLIT SPOON -7.9	P P P
-9.4	12.0		-trace organic clay	100	8	SPLIT SPOON -9.4	2 1 1
-10.9	13.5		Organic CLAY, little peat, very soft, black. (OH)	100	9	SPLIT SPOON -10.9	P P P
-12.4	15.0		PEAT, little organic clay, very soft, fibrous, black, trace shell fragments. (Pt)	100	10	SPLIT SPOON -12.4	2 1 1
			High Plasticity CLAY, trace plant fragments, very soft, olive green. (CH) -soft, trace quartz sand	100	11	SPLIT SPOON -13.9	P P P
			-medium stiff	100	12	SPLIT SPOON -15.4	3 2 2
			-olive green to gray	100	13	SPLIT SPOON -16.9	P 2 3
			-stiff, trace silt	100	14	SPLIT SPOON -18.4	2 2 4
				100	15	SPLIT SPOON -19.9	2 4 6
						(continued)	

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT	HOLE NUMBER
Martin Pena Project, San Juan, P.R.	CB-MP98-14

Hole No.CB-MP98-14

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 2.622 Ft.	SHEET 2 OF 3
PROJECT Martin Pena Project, San Juan, P.R.	INSTALLATION Jacksonville District	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'	Depth scale
-19.9	22.5					-19.9		22.5
			-some quartz sand, very stiff	100	16	SPLIT SPOON -21.4	3 8 12	
			-as above	100	17	SPLIT SPOON -22.9	10 6 18	25
			-hard, brown	100	18	SPLIT SPOON -24.4	19 22 25	
			-trace quartz sand, brown to reddish brown, gray	100	19	SPLIT SPOON -25.9	11 14 18	27.5
			-gray to brown, trace red quartz sand, no silt	100	20	SPLIT SPOON -27.4	13 19 20	
			-as above	100	21	SPLIT SPOON -28.9	6 11 20	30
			-little silt	100	22	SPLIT SPOON -30.4	20 25 21	32.5
			-trace quartz sand, brown	100	23	SPLIT SPOON -31.9	12 16 19	
			-trace quartz sand.	100	24	SPLIT SPOON -33.4	16 24 24	35
			-as above	100	25	SPLIT SPOON -34.9	13 16 22	37.5
			-as above	100	26	SPLIT SPOON -36.4	13 24 30	
			-as above	100	27	SPLIT SPOON -37.9	15 20 27	40
			-reddish brown to brown	66.7	28	SPLIT SPOON -39.4	3 9 23	
			-as above	100	29	SPLIT SPOON -40.9	33 26 39	42.5
-42.4	45.0		-no quartz sand	100	30	SPLIT SPOON -42.4	30 31 39	45
			Sandy CLAY, hard, yellow to dark yellowish brown. (CL)	100	31	SPLIT SPOON -43.9	16 17 18	
-45.4	48.0		-as above	100	32	SPLIT SPOON -45.4	10 21 29	47.5
-46.9	49.5		CLAY, hard, dark yellowish brown and red. (CH)	100	33	SPLIT SPOON -46.9	18 22 27	
			SAND, some silty clay, dense, yellowish brown. (SC)	100	34	SPLIT SPOON	15	50
						(continued)		

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.
MAR 71

PROJECT	HOLE NUMBER
Martin Pena Project, San Juan, P.R.	CB-MP98-14

Hole No.CB-MP98-14

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE	SHEET 3 OF 3
2.622 Ft.	

PROJECT	INSTALLATION
Martin Pena Project, San Juan, P.R.	Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-47.4	50.0						
-48.4	51.0			100	34	SPLIT SPOON -48.4	17 22

END OF BORING CB-MP98-14 AT 51.0 FEET DEPTH.

NOTES:

Soils are field visually classified in accordance with the Unified Soils Classification System.

140# Hammer with 30" drop used on 2.0 foot split spoon (1-3/8" I.D. x 2" O.D.)

P=sampler was pushed into the ground only by the weight of the hammer.

Sample No.	Moisture Content%	Spec. Gravity	Att. Limits L.L.	P.I.
13	38.8	--	53.8	28.0
16	27.7	2.75	52.0	29.6
20	39.5	2.73	81.5	51.5
24	31.9	2.81	95.5	55.5

-50 -52.5 -55 -57.5 -60 -62.5 -65 -67.5 -70 -72.5 -75 -77.5

Hole No.CB-MP98-15

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 3
1. PROJECT Martin Pena Project, San Juan, P.R.		10. SIZE AND TYPE OF BIT See Remarks	
2. LOCATION (Coordinates or Station) X=633,484 Y=217,331		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY GEO CIM, INC.		12. MANUFACTURER'S DESIGNATION OF DRILL CME-55	
4. HOLE NO. (As shown on drawing title and file number) CB-MP98-15		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 34 undisturbed: 0	
5. NAME OF DRILLER CARLOS CALDERON		14. TOTAL NUMBER OF CORE BOXES 1	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED		15. ELEVATION GROUND WATER ft.	
		16. DATE HOLE STARTED 05/07/98 COMPLETED 05/07/98	
7. THICKNESS OF BURDEN 51.0 Ft.		17. ELEVATION TOP OF HOLE 0.602 Ft.	
8. DEPTH DRILLED INTO ROCK 0 Ft.		18. TOTAL CORE RECOVERY FOR BORING 95 %	
9. TOTAL DEPTH OF HOLE 51.0 Ft.		19. SIGNATURE OF ENGINEER JORGE PARRA, P.E.	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
.6	.0					.6	
			FILL consisting of CLAY with some gravel and little sand, very stiff, brown; trace root fragments. (CL)	50	1	SPLIT SPOON -.9	10, 15, 9
			-stiff, trace gravel.	66.7	2	SPLIT SPOON -2.4	8, 7, 6
			-medium stiff, gray to brown.	44.4	3	SPLIT SPOON -3.9	6, 4, 3
-3.9	4.5		FILL-CLAY with some gravel and little sand, medium stiff, gray, some organic content. (CL)	38.9	4	SPLIT SPOON -5.4	4, 4, 3
-5.4	6.0		FILL-GRAVEL, angular, well graded, medium dense, gray. (GW)	27.8	5	SPLIT SPOON -6.9	6, 5, 3
-6.9	7.5		Organic CLAY with some peat, very soft, high plasticity, black, strong organic odor. (OH)	100	6	SPLIT SPOON -8.4	P, P, P
			-gray.	94.4	7	SPLIT SPOON -9.9	P, P, P
			-as above.	100	8	SPLIT SPOON -11.4	1, 1, 1
			-soft, some wood, fragments.	100	9	SPLIT SPOON -12.9	P, 3, 1
-12.9	13.5		CLAY little silt, soft, brown. (CH)	100	10	SPLIT SPOON -14.4	2, 2, 2
				100	11	SPLIT SPOON -15.9	P, P, 3
-15.9	16.5		CLAY, little to some silt, medium to soft, brownish red to red. (CL)	100	12	SPLIT SPOON -17.4	3, 3, 7
			-very stiff.	100	13	SPLIT SPOON -18.9	10, 18, 21
				55.6	14	SPLIT SPOON -20.4	3, 10, 12
			-hard.	100	15	SPLIT SPOON -21.9	13, 22, 21
						(continued)	

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT	HOLE NUMBER
Martin Pena Project, San Juan, P.R.	CB-MP98-15

Hole No.CB-MP98-15

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 0.602 Ft.

SHEET 2 OF 3

PROJECT: Martin Pena Project, San Juan, P.R.

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-21.9	22.5					-21.9	
			-as above.	100	16	SPLIT SPOON -23.4	9 18 21
			-sample crumbled upon sampling.	88.9	17	SPLIT SPOON -24.9	7 14 15
-26.4	27.0			88.9	18	SPLIT SPOON -26.4	13 18 22
			High plasticity CLAY, trace sand, hard, brownish red to red. (CH)	100	19	SPLIT SPOON -27.9	14 23 23
				100	20	SPLIT SPOON -29.4	11 19 23
				88.9	21	SPLIT SPOON -30.9	3 3 11
				100	22	SPLIT SPOON -32.4	11 17 22
				88.9	23	SPLIT SPOON -33.9	11 17 21
				100	24	SPLIT SPOON -35.4	10 12 22
			-red and dark yellowish brown.	66.7	25	SPLIT SPOON -36.9	9 15 17
			-high plasticity.	77.8	26	SPLIT SPOON -38.4	10 17 23
			-no recovery.	94.4	27	SPLIT SPOON -39.9	10 13 16
				0	28	SPLIT SPOON -41.4	15 14 17
				100	29	SPLIT SPOON -42.9	9 16 19
				100	30	SPLIT SPOON -44.4	10 15 16
				100	31	SPLIT SPOON -45.9	6 9 13
			-trace sand.	100	32	SPLIT SPOON -47.4	12 16 22
-48.9	49.5			100	33	SPLIT SPOON -48.9	7 12 17
			Sandy CLAY, hard, dark yellowish brown to reddish brown. (CL)	100	34	SPLIT SPOON	7
						(continued)	

Depth scale: 22.5, 25, 27.5, 30, 32.5, 35, 37.5, 40, 42.5, 45, 47.5, 50

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 2.008 Ft.

PROJECT: Martin Pena Project, San Juan, P.R.

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
-20.5	22.5					-20.5	
			-silty, olive.	100	16	SPLIT SPOON -22.0	3, 6, 4
			-as above.	100	17	SPLIT SPOON -23.5	4, 3, 5
-23.5	25.5		Clayey SILT, stiff, brown. (ML)	100	18	SPLIT SPOON -25.0	4, 6, 6
			-very stiff.	100	19	SPLIT SPOON -26.5	6, 8, 8
-26.5	28.5		High Plasticity SILT, trace sand, very stiff, brown to reddish brown. (MH)	100	20	SPLIT SPOON -28.0	5, 6, 9
			-stiff.	100	21	SPLIT SPOON -29.5	5, 8, 6
-29.5	31.5		High Plasticity SILT, very stiff, brown. (MH)	94.4	22	SPLIT SPOON -31.0	7, 7, 8
			-as above.	100	23	SPLIT SPOON -32.5	5, 7, 9
			-as above.	94.4	24	SPLIT SPOON -34.0	5, 9, 9
-34.0	36.0		High Plasticity Silty CLAY, very stiff, brown to reddish brown. (CH)	100	25	SPLIT SPOON -35.5	9, 11, 11
			-some silt.	100	26	SPLIT SPOON -37.0	7, 13, 13
			-as above.	100	27	SPLIT SPOON -38.5	10, 12, 15
			-brown.	100	28	SPLIT SPOON -40.0	8, 11, 12
			-hard	100	29	SPLIT SPOON -41.5	9, 13, 19
			-little silt.	100	30	SPLIT SPOON -43.0	9, 11, 11
			-as above.	66.7	31	SPLIT SPOON -44.5	4, 6, 14
			-trace sand consisting of quartz and terrigenous material.	100	32	SPLIT SPOON -46.0	7, 13, 16
			-as above.	77.8	33	SPLIT SPOON -47.5	7, 10, 14
-47.5	49.5		High Plasticity SILT, very stiff, brown.	66.7	34	SPLIT SPOON	10
						(continued)	

Depth scale: 22.5, 25, 27.5, 30, 32.5, 35, 37.5, 40, 42.5, 45, 47.5, 50

Hole No.CB-MP98-12

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 2.008 Ft.	SHEET 3 OF 3
PROJECT: Martin Pena Project, San Juan, P.R.	INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-48.0	50.0						
-49.0	51.0			66.7	34	SPLIT SPOON -49.0	12 / 14

END OF BORING CB-MP98-12 AT 51.0 FEET DEPTH.

NOTES:

Soils are field visually classified in accordance with the Unified Soils Classification System.

140# Hammer with 30" drop used on 2.0 foot split spoon (1-3/8" I.D. x 2" O.D.)

P=sampler was pushed into the ground only by the weight of the hammer.

Sample No.	Moisture Content%	Spec. Gravity	Att. Limits L.L.	Att. Limits P.I.
6	240.4	2.52	--	--
12	34.3	--	56.0	29.6
13	31.2	2.71	--	--
18	33.7	--	--	--
20	33.6	2.80	53.6	24.2
22	36.7	--	58.0	27.0
26	36.3	--	83.5	50.3
34	34.8	2.80	80.0	39.5

Sample No.	Organic Content
6	29.36%

-50 -52.5 -55 -57.5 -60 -62.5 -65 -67.5 -70 -72.5 -75 -77.5

Hole No.CB-MP98-15

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 0.602 Ft.

SHEET 3 OF 3

PROJECT: Martin Pena Project, San Juan, P.R.

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-49.4	50.0						
				100	34	SPLIT SPOON	14
-50.4	51.0					-50.4	16
			END OF BORING CB-MP98-15 AT 51.0 FEET DEPTH.				

NOTES:

Soils are field visually classified in accordance with the Unified Soils Classification System.

140# Hammer with 30" drop used on 2.0 foot split spoon (1-3/8" I.D. x 2" O.D.)

Groundwater level was not recorded.

P=sampler was pushed into the ground only by the weight of the hammer.

Sample No.	Moisture Content%	Spec. Gravity	Att. Limits L.L.	P.I.
7	158.3	--	158.5	80.0
13	28.6	2.84	43.5	18.8
19	28.0	2.85	82.0	49.8
27	--	2.78	100.0	64.6

Sample No.	Organic Content
7	25.1%

-50 -52.5 -55 -57.5 -60 -62.5 -65 -67.5 -70 -72.5 -75 -77.5

Hole No.CB-MP98-16

DRILLING LOG DIVISION South Atlantic	INSTALLATION Jacksonville District — SHEET 1 OF 3
1. PROJECT Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT See Remarks
2. LOCATION (Coordinates or Station) X=634,395 Y=217,144	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL CME-45
4. HOLE NO. (As shown on drawing title and file number) CB-MP98-16	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 31 undisturbed: 0
5. NAME OF DRILLER EVARISTO SANTIAGO	14. TOTAL NUMBER OF CORE BOXES 1
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER 1.297 ft.
	16. DATE HOLE STARTED 06/05/98 COMPLETED 06/05/98
7. THICKNESS OF BURDEN 51.0 Ft.	17. ELEVATION TOP OF HOLE 3.297 Ft.
8. DEPTH DRILLED INTO ROCK 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING 70.6 %
9. TOTAL DEPTH OF HOLE 51.0 Ft.	19. SIGNATURE OF ENGINEER JORGE R. PARRA, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
3.3	.0					3.3	
			FILL consisting of SAND with some gravel and little clay, loose, well -graded, medium to fine, brown. (SW)	50	1	SPLIT SPOON 1.8	2, 2, 4
.3	3.0		-some clay, very loose	33.3	2	SPLIT SPOON .3	1, 1, 1
-1.2	4.5		FILL consisting of Gravelly Clay, medium stiff, brown to dark brown. (CL)	44.4	3	SPLIT SPOON -1.2	2, 2, 3
			-no recovery, see Note 2	0	4	SPLIT SPOON -2.7	6, 4, 2
			-no recovery, see Note 2	0	5	SPLIT SPOON -4.2	2, 2, 3
-5.7	9.0		-no recovery, see Note 2	0	6	SPLIT SPOON -5.7	1, P, P
			Organic CLAY with little peat, very soft, black to dark gray. (OH)	38.9	7	SPLIT SPOON -7.2	P, P, P
-8.7	12.0		-little shell fragments and trace gravel	44.4	8	SPLIT SPOON -8.7	P, P, P
			High Plasticity CLAY with little silt and trace gravel, stiff, brown to reddish brown; trace disseminated oxides. (CH) trace disseminated oxides. (CH)	61.1	9	SPLIT SPOON -10.2	3, 4, 6
			-some silt and little oxide nodules, very stiff	50	10	SPLIT SPOON -11.7	5, 7, 10
			-trace silt	72.2	11	SPLIT SPOON -13.2	5, 6, 9
			-some silt, some disseminated oxides	72.2	12	SPLIT SPOON -14.7	6, 7, 9
			-gray to reddish brown	100	13	SPLIT SPOON -16.2	6, 8, 10
			-gray, no silt, stiff	100	14	SPLIT SPOON -17.7	6, 6, 8
			-very stiff	83.3	15	SPLIT SPOON -19.2	7, 7, 10
						(continued)	

Scale (ft): 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. | PROJECT Martin Pena Project, San Juan, P.R. | HOLE NUMBER CB-MP98-16

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 3.297 Ft.

PROJECT: Martin Pena Project, San Juan, P.R.

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
-19.2	22.5		~~some silt, grey to brown to~~ reddish brown	88.8	16	-19.2 SPLIT SPOON -20.7	7, 8, 9
			-trace silt	88.8	17	SPLIT SPOON -22.2	7, 8, 12
			-as above	88.8	18	SPLIT SPOON -23.7	7, 9, 12
			-trace fine-grained quartz sand	100	19	SPLIT SPOON -25.2	7, 9, 11
			-pale brown, no quartz sand	100	20	SPLIT SPOON -26.7	6, 9, 12
			-as above	88.9	21	SPLIT SPOON -28.2	6, 9, 12
			trace quartz sand and trace disseminated oxides	94.4	22	SPLIT SPOON -29.7	7, 9, 11
			trace coarse to very coarse quartz sand	100	23	SPLIT SPOON -31.2	8, 10, 12
			trace medium quartz sand	100	24	SPLIT SPOON -32.7	8, 10, 12
			-no sand	100	25	SPLIT SPOON -34.2	7, 9, 12
			-stiff, little to some coarse quartz sand	100	26	SPLIT SPOON -35.7	6, 6, 5
-35.7	39.0		Sandy CLAY, some thoroughly weathered limestone fragments, stiff, brown; sand consists of fine quartz sand. (CL)	50	27	SPLIT SPOON -37.2	5, 7, 5
-37.2	40.5		LIMESTONE FORMATION: Thoroughly to highly weathered limestone (Wackestone) fragments, some clay and little quartz sand, dense, well graded, brown. (GC)	94.4	28	SPLIT SPOON -38.7	11, 20, 12
			-little clay, some quartz sand	66.6	29	SPLIT SPOON -40.2	6, 14, 10
			-some clay	61.1	30	SPLIT SPOON -41.7	6, 10, 10
			-highly to moderately weathered and moderately hard	72.2	31	SPLIT SPOON -43.2	5, 10, 13
			-highly weathered, low hardness	77.8	32	SPLIT SPOON -44.7	10, 18, 18
-44.7	48.0		-Sampled as Sandy Gravel, well graded, some clay. medium dense, pale brown; gravel consists of thoroughly to highly weathered limestone and sand ~~(mostly queortz sand). (GW)~~	88.9	33	SPLIT SPOON -46.2	6, 7, 8
				88.9	34	SPLIT SPOON	7
						(continued)	

Depth scale: 22.5, 25, 27.5, 30, 32.5, 35, 37.5, 40, 42.5, 45, 47.5, 50

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Martin Pena Project, San Juan, P.R. | HOLE NUMBER: CB-MP98-16

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 3.297 Ft.

PROJECT: Martin Pena Project, San Juan, P.R.

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-46.7	50.0						
-47.7	51.0		-as above	88.9	34	-47.7 SPLIT SPOON	11 / 13

END OF BORING CB-MP98-16 AT 51.0 FEET DEPTH.

NOTES:

1) Soils are field visually classified in accordance with the Unified Soils Classification System.

2) The drilling foreman reported no recovery due to apparently sampling into rubber material (rubber tires?)

140# Hammer with 30" drop used on 2.0 foot split spoon (1-3/8" I.D. x 2" O.D.)

P=sampler was pushed into the ground only by the weight of the hammer.

Sample No.	Moisture Content%	Spec. Gravity	Att. Limits L.L.	P.I.
12	34.5	2.70	92.0	61.1
19	35.6	2.76	110.0	80.8

-50 -52.5 -55 -57.5 -60 -62.5 -65 -67.5 -70 -72.5 -75 -77.5

Hole No.CB-MP98-17

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 3

1. PROJECT Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT See Remarks
2. LOCATION (Coordinates or Station) X=634,040 Y=216,863	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL CME-55
4. HOLE NO. (As shown on drawing title and file number) CB-MP98-17	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 34 undisturbed: 0
5. NAME OF DRILLER JOSE AYALA	14. TOTAL NUMBER OF CORE BOXES 1
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER 1.729 ft.
	16. DATE HOLE STARTED 06/01/98 COMPLETED 06/02/98
7. THICKNESS OF BURDEN 51.0 Ft.	17. ELEVATION TOP OF HOLE 2.729 Ft.
8. DEPTH DRILLED INTO ROCK 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING 95.9 %
9. TOTAL DEPTH OF HOLE 51.0 Ft.	19. SIGNATURE OF ENGINEER JORGE R. PARRA, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
2.7	.0					2.7	
			FILL-CLAY, some sand and gravel, very stiff, black to brown; trace trash. (CL)	100	1	SPLIT SPOON	13 / 11 / 11
1.2	1.5					1.2	
			FILL-GRAVEL, some clay, medium dense, angular, well graded, brown. (GC)	100	2	SPLIT SPOON	10 / 6 / 12
						-.3	
			-little clay	100	3	SPLIT SPOON	8 / 4 / 5
						-1.8	
			-as above	100	4	SPLIT SPOON	6 / 5 / 4
-3.3	6.0					-3.3	
			Peat, very soft, fibrous, black to dark brown. (Pt)	100	5	SPLIT SPOON	P / P / P
						-4.8	
			-trace clay	94.4	6	SPLIT SPOON	2 / 1 / 1
						-6.3	
			-as above	100	7	SPLIT SPOON	P / P / P
-7.8	10.5					-7.8	
			CLAY, trace quartz sand, very soft, brown to dark olive green; some decomposing plant fragments. (OH)	100	8	SPLIT SPOON	P / P / P
						-9.3	
			-medium stiff	94.4	9	SPLIT SPOON	1 / 1 / 4
-10.8	13.5					-10.8	
			High Plasticity CLAY, very stiff, gray to brown, trace decomposing plant fragments. (CH)	100	10	SPLIT SPOON	6 / 9 / 17
						-12.3	
			-hard, little clay, trace desseminated oxides, reddish brown to gray	100	11	SPLIT SPOON	11 / 12 / 18
						-13.8	
			-little disseminated oxides	94.4	12	SPLIT SPOON	17 / 24 / 31
						-15.3	
			-very stiff, little disseminated oxides, trace silt	77.8	13	SPLIT SPOON	3 / 7 / 18
						-16.8	
			-hard, gray, brown, reddish brown	100	14	SPLIT SPOON	20 / 18 / 23
-18.3	21.0					-18.3	
			CLAY, very stiff, gray. (CH)	100	15	SPLIT SPOON	6 / 11 / 15
						-19.8	
						(continued)	

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.CB-MP98-17

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 2.729 Ft.

SHEET 2 OF 3

PROJECT: Martin Pena Project, San Juan, P.R.

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
-19.8	22.5					-19.8	
			-hard, some oxide nodules, brown to reddish brown -very stiff, trace oxide nodules	100	16	SPLIT SPOON -21.3	31 37 38
				50	17	SPLIT SPOON -22.8	8 5 20
			-hard, some silt, trace sand	100	18	SPLIT SPOON -24.3	20 28 33
			-very stiff, trace silt	77.8	19	SPLIT SPOON -25.8	7 10 18
-27.3	30.0		-hard, little medium-grained quartz sand	77.8	20	SPLIT SPOON -27.3	12 16 25
			CLAY, some black to gray, medium-grained quartz sand, very stiff. (CL)	100	21	SPLIT SPOON -28.8	14 9 20
-30.3	33.0		Sandy CLAY, hard, brown to black; (sand portion consisting of medium- grained quartz sand). (CL)	94.4	22	SPLIT SPOON -30.3	18 22 27
			Quartz SAND, trace silt, very dense, poorly-graded, coarse, very pale brown. (SP) -little silt	100	23	SPLIT SPOON -31.8	11 17 27
-33.3	36.0			100	24	SPLIT SPOON -33.3	23 47 22
			LIMESTONE FORMATION sampled as Sandy-Gravelly in a Clay matrix, sand and gravel portion consist of limestone, yellowish brown; limestone is thoroughly weathered and has low hardness, quick reaction to HCL. (CL)	100	25	SPLIT SPOON -34.8	25 18 17
				100	26	SPLIT SPOON -36.3	10 19 15
			-as above	100	27	SPLIT SPOON -37.8	10 15 21
				100	28	SPLIT SPOON -39.3	15 15 14
				100	29	SPLIT SPOON -40.8	13 14 15
				100	30	SPLIT SPOON -42.3	8 15 12
			-brown	100	31	SPLIT SPOON -43.8	15 15 16
				100	32	SPLIT SPOON -45.3	12 19 28
				100	33	SPLIT SPOON -46.8	16 20 21
				100	34	SPLIT SPOON	10
						(continued)	

Depth scale: -22.5, -25, -27.5, -30, -32.5, -35, -37.5, -40, -42.5, -45, -47.5, -50

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 2.729 Ft.

PROJECT: Martin Pena Project, San Juan, P.R.

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-47.3	50.0						
				100	34	SPLIT SPOON	19 / 25
-48.3	51.0					-48.3	

END OF BORING CB-MP98-17 AT 51.0 FEET DEPTH.

NOTES:

Soils are field visually classified in accordance with the Unified Soils Classification System.

140# Hammer with 30" drop used on 2.0 foot split spoon (1-3/8" I.D. x 2" O.D.)

P=sampler was pushed into the ground only by the weight of the hammer.

Sample No.	Moisture Content%	Spec. Gravity	Att. Limits L.L.	Att. Limits P.I.
11	28.6	2.88	68.0	44.3
18	31.2	2.73	84.0	48.4

Elevation scale: -50, -52.5, -55, -57.5, -60, -62.5, -65, -67.5, -70, -72.5, -75, -77.5

Hole No.CB-MP98-20

DRILLING LOG

DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 3
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=635,355 Y=217,262	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: CME-55
4. HOLE NO. (As shown on drawing title and file number): CB-MP98-20	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 34 undisturbed: 0
5. NAME OF DRILLER: JOSE AYALA	14. TOTAL NUMBER OF CORE BOXES: 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: -.178 ft.
	16. DATE HOLE: STARTED 06/03/98 COMPLETED 06/04/98
7. THICKNESS OF BURDEN: 51.0 Ft.	17. ELEVATION TOP OF HOLE: 2.822 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 74.7 %
9. TOTAL DEPTH OF HOLE: 51.0 Ft.	19. SIGNATURE OF ENGINEER: JORGE R. PARRA, P.E. JRP

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
2.8	.0					2.8	
			FILL-SILT, some gravel, very stiff, brown. (ML)	44.4	1	SPLIT SPOON	6 7 4
			-sandy			1.3	
				55.6	2	SPLIT SPOON	3 4 7
			-soft			-.2	
-1.7	4.5			16.7	3	SPLIT SPOON -1.7	4 1 3
-3.2	6.0		FILL-Wood fragments with little organic clay, black.	11.1	4	SPLIT SPOON -3.2	6 1 1
-4.7	7.5		Organic CLAY, little peat, very soft, black. (OH)	22.2	5	SPLIT SPOON -4.7	P P P
-6.2	9.0		Peat, very soft, fibrous, black to dark brown; little shell fragments. (Pt)	88.9	6	SPLIT SPOON -6.2	P P 2
			High Plasticity CLAY, trace sand, soft, brown to gray. (CH)	94.4	7	SPLIT SPOON -7.7	2 1 2
			-little wood fragments	55.6	8	SPLIT SPOON -9.2	2 4 8
-10.7	13.5		-very soft	77.8	9	SPLIT SPOON -10.7	2 2 5
-12.2	15.0		Silty CLAY, very stiff, brown to reddish brown, trace disseminated oxides. (CL-ML)	66.7	10	SPLIT SPOON -12.2	13 13 15
			Low Plasticity CLAY, trace sand, hard, reddish brown, little disseminated oxides. (CL)	72.2	11	SPLIT SPOON -13.7	8 13 19
			-some disseminated oxides.	77.8	12	SPLIT SPOON -15.2	17 27 26
-16.7	19.5			94.4	13	SPLIT SPOON -16.7	12 14 18
-18.2	21.0		Sandy CLAY, hard, gray; sand consists of fine quartz sand. (CL)	66.7	14	SPLIT SPOON -18.2	19 22 30
			CLAY, trace silt, hard, reddish brown. (CH)	88.9	15	SPLIT SPOON -19.7	10 15 22
						(continued)	

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT: Martin Pena Project, San Juan, P.R. HOLE NUMBER: CB-MP98-20

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 2.822 Ft.

PROJECT: Martin Pena Project, San Juan, P.R.

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
-19.7	22.5					-19.7	
			-no silt, high plasticity, reddish-brownish gray	100	16	SPLIT SPOON -21.2	21, 21, 18
			-as above	88.9	17	SPLIT SPOON -22.7	18, 16, 25
			-trace silt	77.8	18	SPLIT SPOON -24.2	12, 29, 32
			-trace oxide nodules	77.8	19	SPLIT SPOON -25.7	16, 22, 26
			-trace fine quartz sand	77.8	20	SPLIT SPOON -27.2	21, 26, 31
-28.7	31.5		-trace fine to medium quartz sand and some disseminated oxides.	77.8	21	SPLIT SPOON -28.7	5, 20, 27
			Quartz SAND, medium, very dense, poorly-graded, subangular, brown. (SP)	100	22	SPLIT SPOON -30.2	12, 26, 39
			-trace clay, dense	55.6	23	SPLIT SPOON -31.7	9, 12, 23
			-as above	100	24	SPLIT SPOON -33.2	17, 22, 25
-34.7	37.5		-no clay	100	25	SPLIT SPOON -34.7	29, 17, 12
-36.2	39.0		CLAY, little quartz sand, hard, brown. (CL)	100	26	SPLIT SPOON -36.2	21, 31, 36
			Quartz SAND, little clay, poorly-graded, dense, medium to coarse, brown. (SP)	100	27	SPLIT SPOON -37.7	13, 16, 16
			-black to gray	100	28	SPLIT SPOON -39.2	11, 15, 13
-40.7	43.5		-clayey to quartz sand	100	29	SPLIT SPOON -40.7	12, 13, 15
			High Plasticity CLAY, trace quartz sand, very stiff, brown. (CH)	33.3	30	SPLIT SPOON -42.2	6, 10, 12
			-trace quartz sand, hard	55.6	31	SPLIT SPOON -43.7	14, 19, 24
			-trace quartz sand	77.8	32	SPLIT SPOON -45.2	36, 34, 34
			-no quartz sand	94.4	33	SPLIT SPOON -46.7	20, 21, 31
			-some quartz sand	88.9	34	SPLIT SPOON	18
						(continued)	

Depth scale: 22.5, 25, 27.5, 30, 32.5, 35, 37.5, 40, 42.5, 45, 47.5, 50

Hole No.CB-MP98-20

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 2.822 Ft.	SHEET 3 OF 3
PROJECT Martin Pena Project, San Juan, P.R.	INSTALLATION Jacksonville District	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-47.2	50.0						
-48.2	51.0			88.9	34	SPLIT SPOON -48.2	24 24

END OF BORING CB-MP98-20 AT 51.0 FEET DEPTH.

NOTES:

1. Soils are field visually classified in accordance with the Unified Soils Classification System.

2. 140# Hammer with 30" drop used on 2.0 foot split spoon (1-3/8" I.D. x 2" O.D.)

3. P= sampler was pushed into the ground only by the weight of the hammer.

Sample No.	Moisture Content%	Spec. Gravity	Att. Limits L.L.	P.I.
8	41.4	2.72	52.5	26.8
12	25.7	2.78	55.0	32.0
13	22.9	2.75	46.3	27.1
16	32.1	2.67	91.0	56.2
30	25.2	--	--	--
31	32.0	2.69	89.0	58.5
32	37.5	2.81	84.5	51.0

-50 -52.5 -55 -57.5 -60 -62.5 -65 -67.5 -70 -72.5 -75 -77.5

Hole No.CB-MP98-21

DRILLING LOG — DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 3
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION *(Coordinates or Station)*: X=635,703 Y=216,689	11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*: MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: CME-55
4. HOLE NO. *(As shown on drawing title and file number)*: CB-MP98-21	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 34 undisturbed: 0
5. NAME OF DRILLER: JOSE AYALA	14. TOTAL NUMBER OF CORE BOXES: 1
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: -0.488 ft.
	16. DATE HOLE: STARTED 05/29/98 COMPLETED 06/01/98
7. THICKNESS OF BURDEN: 51.0 Ft.	17. ELEVATION TOP OF HOLE: 1.012 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: 82.0 %
9. TOTAL DEPTH OF HOLE: 51.0 Ft.	19. SIGNATURE OF ENGINEER: JORGE R. PARRA, P.E. JRP

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
1.0	.0					1.0	
-.5	1.5		FILL-CLAY, some sand and gravel, soft, brown. (CL)	11.1	1	SPLIT SPOON -.5	1, 1, 2
-2.0	3.0		FILL-GRAVEL, some sand and trace silt, medium dense, black. (GW)	11.1	2	SPLIT SPOON -2.0	2, 2, 7
-3.5	4.5		Silty CLAY, little gravel, stiff, brown. (CL-ML)	33.3	3	SPLIT SPOON -3.5	4, 2, 5
-5.0	6.0		GRAVEL, some peat, medium dense, well graded, black. (GW)	94.4	4	SPLIT SPOON -5.0	5, 10, 8
			GRAVEL, some clay and sand, medium dense, well graded, gray; (gravel consists of limestone fragments). (GC)	100	5	SPLIT SPOON -6.5	3, 7, 19
			-as above	88.9	6	SPLIT SPOON -8.0	14, 13, 12
-9.5	10.5		-as above	83.3	7	SPLIT SPOON -9.5	5, 5, 19
			LIMESTONE Formation sampled as Gravel, some silty clay, (Wackestone) highly to moderately weathered, hard, brown to very pale brown. (GC)	100	8	SPLIT SPOON -11.0	14, 34, 37
			-as above	100	9	SPLIT SPOON -12.5	26, 30, 33
-14.0	15.0		-some clay, brown to white	100	10	SPLIT SPOON -14.0	34, 30, 46
-15.5	16.5		Sampled as Gravelly CLAY, hard, brown. (CL)	100	11	SPLIT SPOON -15.5	18, 22, 27
			LIMESTONE (Wackestone), sampled as Gravel, little clay; moderately weathered, moderatley hard, brown to white. (GC)	16.7	12	SPLIT SPOON -17.0	100
			-some clay	100	13	SPLIT SPOON -18.5	32, 45, 32
-20.0	21.0		-brown to white	77.8	14	SPLIT SPOON -20.0	23, 28, 29
-21.5	22.5		Sampled as Sandy CLAY, little gravel, hard, brown. (CL)	44.4	15	SPLIT SPOON -21.5	21, 17, 17
						(continued)	

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.CB-MP98-21

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 1.012 Ft.

SHEET 2 OF 3

PROJECT: Martin Pena Project, San Juan, P.R.

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
-21.5	22.5					-21.5	
-23.0	24.0		Sandy CLAY, little gravel, very stiff, brown to gray; sand consists quartz sand,and gravel consists of limestone fragments. (CL)	88.9	16	SPLIT SPOON -23.0	7 / 14 / 13
			sampled as Gravel (Wackestone) with trace clay and sand, highly weathered, low hardness, brown to white. (GW)	88.9	17	SPLIT SPOON -24.5	8 / 8 / 9
-26.0	27.0		-as above	100	18	SPLIT SPOON -26.0	26 / 28 / 15
			Gravelly CLAY, hard, brown; gravel consists of limestone fragments. (CL)	100	19	SPLIT SPOON -27.5	7 / 20 / 17
-29.0	30.0		-brown to white	77.8	20	SPLIT SPOON -29.0	12 / 15 / 19
			Clayey GRAVEL, medium dense, well graded, subangular, brown. (GC)	100	21	SPLIT SPOON -30.5	5 / 12 / 10
			-dense	100	22	SPLIT SPOON -32.0	15 / 14 / 17
-33.5	34.5		-very dense	66.7	23	SPLIT SPOON -33.5	12 / 100
-35.0	36.0		sampled as Gravel, (Wackestone), little clay and sand, low to moderately hard, higly to moderately weathered, pale brown. (GC)	77.8	24	SPLIT SPOON -35.0	48 / 13 / 13
			CLAY, some gravel, very stiff, brown; gravel consists of limestone fragments. (CL)	88.9	25	SPLIT SPOON -36.5	10 / 8 / 10
			-hard, little quartz sand	100	26	SPLIT SPOON -38.0	14 / 24 / 16
-39.5	40.5		-very stiff, trace quartz sand	100	27	SPLIT SPOON -39.5	4 / 8 / 13
			Gravelly CLAY, some sand, hard, brown; gravel consist of limestone fragments. (CL)	88.9	28	SPLIT SPOON -41.0	5 / 22 / 10
			-little quartz sand	77.8	29	SPLIT SPOON -42.5	10 / 40 / 22
			-some gravel, very stiff	100	30	SPLIT SPOON -44.0	11 / 9 / 10
			-gravelly, hard	88.9	31	SPLIT SPOON -45.5	5 / 20 / 30
			-as above	100	32	SPLIT SPOON -47.0	11 / 30 / 50
-48.5	49.5		-as above	94.4	33	SPLIT SPOON -48.5	17 / 22 / 23
			sampled as Gravel, some clay, moderately weathered, moderately hard, pale brown to white. (GC)	100	34	SPLIT SPOON	19
						(continued)	

Depth scale: 22.5, 25, 27.5, 30, 32.5, 35, 37.5, 40, 42.5, 45, 47.5, 50

Hole No.CB-MP98-21

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE	SHEET 3 OF 3
1.012 Ft.	

PROJECT	INSTALLATION
Martin Pena Project, San Juan, P.R.	Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
-49.0	50.0						
-50.0	51.0			100	34	-50.0 SPLIT SPOON	16 / 100
			END OF BORING CB-MP98-21 AT 51.0 FEET DEPTH. NOTES: Soils are field visually classified in accordance with the Unified Soils Classification System. 140# Hammer with 30" drop used on 2.0 foot split spoon (1-3/8" I.D. x 2" O.D.)				

-50 -52.5 -55 -57.5 -60 -62.5 -65 -67.5 -70 -72.5 -75 -77.5

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.
MAR 71

PROJECT	HOLE NUMBER
Martin Pena Project, San Juan, P.R.	CB-MP98-21

Hole No.CB-MP98-22

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 3

1. PROJECT Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT See Remarks
2. LOCATION (Coordinates or Station) X=636,634 Y=217,056	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL CME-55
4. HOLE NO. (As shown on drawing title and file number) CB-MP98-22	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 34 undisturbed: 0
5. NAME OF DRILLER CARLOS CALDERON	14. TOTAL NUMBER OF CORE BOXES 1
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER
	16. DATE HOLE STARTED 05/12/98 COMPLETED 05/12/98
7. THICKNESS OF BURDEN 51.0 Ft.	17. ELEVATION TOP OF HOLE 0.855 Ft.
8. DEPTH DRILLED INTO ROCK 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING 67.3 %
9. TOTAL DEPTH OF HOLE 51.0 Ft.	19. SIGNATURE OF ENGINEER JORGE R. PARRA, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
.9	.0					.9	
			FILL consisting of gravel with wood fragments and trash, medium dense, well graded, brown.	16.7	1	SPLIT SPOON -.6	2 7 11
-2.1	3.0		-no wood fragments in trash, loose to very loose	11.1	2	SPLIT SPOON -2.1	6 1 1
			Wood fragments with some organic clay, soft, dark brown.	33.3	3	SPLIT SPOON -3.6	1 2 2
-5.1	6.0		NO RECOVERY	0	4	SPLIT SPOON -5.1	P P P
			Organic CLAY, very soft, black, strong organic odor. (OH)	27.8	5	SPLIT SPOON -6.6	P P P
			-trace gravel, some plant fragments and little shell fragments.	44.4	6	SPLIT SPOON -8.1	P P P
-9.6	10.5		-trace sand	38.9	7	SPLIT SPOON -9.6	P P P
			Peat, some organic clay, very soft, fibrous, black; little shell fragments.	50.0	8	SPLIT SPOON -11.1	P P P
-12.6	13.5		NO RECOVERY	0	9	SPLIT SPOON -12.6	P P P
			Organic CLAY, some wood fragmentsm very soft, dark brown. (OH)	33.3	10	SPLIT SPOON -14.1	P P P
			-little peat	44.4	11	SPLIT SPOON -15.6	P P P
-17.1	18.0		-as above	38.9	12	SPLIT SPOON -17.1	P P P
			CLAY, little wood fragments, very soft, pale gray. (CH)	88.9	13	SPLIT SPOON -18.6	P P P
			-NO RECOVERY	0	14	SPLIT SPOON -20.1	P P P
			-as above, trace gravel and sand.	38.9	15	SPLIT SPOON -21.6	P P P
						(continued)	

Scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT	HOLE NUMBER
Martin Pena Project, San Juan, P.R.	CB-MP98-22

Hole No.CB-MP98-22

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 0.855 Ft.

SHEET 2 OF 3

PROJECT: Martin Pena Project, San Juan, P.R.

INSTALLATION: Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/.5'
-21.6	22.5					-21.6	
				77.8	16	SPLIT SPOON	2, 2, 3
-23.1	24.0					-23.1	
			CLAY, trace gravel and trace wood fragments, very stiff, olive green. (CH)	100	17	SPLIT SPOON	5, 7, 7
						-24.6	
			-pale brown	100	18	SPLIT SPOON	7, 10, 16
						-26.1	
			-medium stiff, olive green	100	19	SPLIT SPOON	2, 2, 3
						-27.6	
			-stiff	100	20	SPLIT SPOON	2, 3, 9
-29.1	30.0					-29.1	
			CLAY, hard, brown to reddish brown. (CH)	100	21	SPLIT SPOON	12, 17, 22
						-30.6	
			-as above	94.4	22	SPLIT SPOON	7, 15, 17
						-32.1	
			-very stiff	100	23	SPLIT SPOON	7, 13, 14
						-33.6	
			-trace disseminated oxides.	100	24	SPLIT SPOON	7, 12, 16
						-35.1	
			-pale brown	100	25	SPLIT SPOON	8, 12, 13
-36.6	37.5					-36.6	
			CLAY with some quartz sand lenses, very stiff, pale brown; (sand is well-graded). (CL)	94.4	26	SPLIT SPOON	9, 13, 14
						-38.1	
			-no sand	100	27	SPLIT SPOON	5, 9, 12
						-39.6	
			-as above	88.9	28	SPLIT SPOON	12, 14, 14
-41.1	42.0					-41.1	
			Quartz SAND with trace clay, poorly-graded, medium dense, brown. (SP)	100	29	SPLIT SPOON	5, 7, 10
-42.6	43.5					-42.6	
			Limestone Formation, sampled as CLAY, some sand, trace gravel-sized Limestone fragments, yellowish brow. (CL)	100	30	SPLIT SPOON	6, 9, 10
-44.1	45.0					-44.1	
			SAND, trace clay, medium dense, brown. (SP)	100	31	SPLIT SPOON	6, 9, 14
						-45.6	
			Clayey SAND, dense, little gravel-sized Limestone fragments, brown. (SC)	100	32	SPLIT SPOON	7, 24, 14
						-47.1	
			-same as above	83.3	33	SPLIT SPOON	30, 19, 11
						-48.6	
			-sampled as Sandy Clay, hard, little Limestone fragments, dark ~~yellowish brown. (CH)~~	83.3	34	SPLIT SPOON	5
						(continued)	

Depth scale: 22.5, 25, 27.5, 30, 32.5, 35, 37.5, 40, 42.5, 45, 47.5, 50

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Martin Pena Project, San Juan, P.R. | HOLE NUMBER: CB-MP98-22

Hole No.CB-MP98-22

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 0.855 Ft.

SHEET 3 OF 3

PROJECT Martin Pena Project, San Juan, P.R.

INSTALLATION Jacksonville District

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	BLOWS/ .5'
-49.1	50.0						
-50.1	51.0			83.3	34	SPLIT SPOON -50.1	12 / 14

END OF BORING CB-MP98-22 AT 51.0 FEET DEPTH.

NOTES:

1. Soils are field visually classified in accordance with the Unified Soils Classification System.

2. 140# Hammer with 30" drop used on 2.0 foot split spoon (1-3/8" I.D. x 2" O.D.)

3. P= sampler was pushed into the ground only by the weight of the hammer.

4. Groundwater level was not recorded.

Sample No.	Moisture Content%	Spec. Gravity	Att. Limits L.L.	P.I.
6	144.7	2.53	--	--
7	220.8	--	84.0	35.0
8	167.5	--	95.5	42.6
13	--	--	73.0	45.3
15	98.9	2.68	--	--
17	75.4	--	56.5	28.1
23	36.8	2.72	80.9	50.0
30	33.5	--	--	--

Sample No.	Organic Content
6	22.96%
8	24.93%

-50
-52.5
-55
-57.5
-60
-62.5
-65
-67.5
-70
-72.5
-75
-77.5

Hole No.TP-MP98-01

DRILLING LOG

DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 1
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=629,306 Y=218,955	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. (As shown on drawing title and file number): TP-MP98-01	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 6 undisturbed: 0
5. NAME OF DRILLER: GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES: 0
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 04/29/98, COMPLETED 04/29/98
7. THICKNESS OF BURDEN: 12.58 Ft.	17. ELEVATION TOP OF HOLE: 3.434 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: N/A %
9. TOTAL DEPTH OF HOLE: 12.6 Ft.	19. SIGNATURE OF ENGINEER: Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
3.4	.0					3.4
.9	2.5		FILL consisting of gravelly silty CLAY with some boulder sized concrete slabs and metal, root and plant fragments, dark brown. (CL)		1	BACKHOE .9
-.6	4.0		FILL consisting of silty CLAY with some gravel, brown. (CL)		2	BACKHOE -.6
-1.2	4.7		Organic CLAY with trace sand and decomposing matter, very soft, strong organic odor, black, the water percolated into the trench only from this stratum. (OH)		3	BACKHOE -1.2
-2.1	5.5		Sandy CLAY, some decomposing plant fragments, brown to pale brown to purple. (CL)		4	BACKHOE -2.1
-3.6	7.0		CLAY, some to little silt and trace sand, some decomposing plant fragments, brown. (CH)		5	BACKHOE -3.6
-9.1	12.6		Sandy CLAY, trace decomposing plant fragments, gray. (CL)		6	BACKHOE -9.1

END OF TEST PIT TP-MP98-01 AT 12.58 FEET DEPTH.

NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System.

Groundwater reading was not taken.

Scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.TP-MP98-02

DRILLING LOG

DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 1
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=629,396 Y=218,678	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. (As shown on drawing title and file number): TP-MP98-02	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 3 undisturbed: 0
5. NAME OF DRILLER: GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES: 0
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: −0.686 Ft.
	16. DATE HOLE: STARTED 04/29/98 COMPLETED 04/29/98
7. THICKNESS OF BURDEN: 12.0 Ft.	17. ELEVATION TOP OF HOLE: 6.686 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: N/A %
9. TOTAL DEPTH OF HOLE: 12.0 Ft.	19. SIGNATURE OF ENGINEER: Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
6.7	.0					6.7
1.2	5.5		FILL consisting of construction rubble, mostly concrete blocks up to boulder in size and rock fragments, some trash and scrap metal on a dark brown sandy silt matrix. Note: smaller size gravel were on top of this layer while boulders are found at the bottom of this layer.		1	BACKHOE 1.2
−4.3	11.0		GRAVEL, organic SILT and CLAY with some sand, some construction debris, wood fragments and household trash, strong organic odor, dark gray. (GC)		2	BACKHOE −4.3
−5.3	12.0		PEAT with organic clay, fibrous, very soft, black. (Pt)		3	BACKHOE −5.3
			END OF TEST PIT TP-MP98-02 AT 12.0 FEET DEPTH. NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System.			

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT	HOLE NUMBER
Martin Pena Project, San Juan, P.R.	TP-MP98-02

Hole No.TP-MP98-03

DRILLING LOG — DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 1
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=629,666 Y=218,897	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. (As shown on drawing title and file number): TP-MP98-03	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 3 undisturbed: 0
5. NAME OF DRILLER: GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES: 0
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: ft.
	16. DATE HOLE: STARTED 05/07/98 COMPLETED 05/07/98
7. THICKNESS OF BURDEN: 12.0 Ft.	17. ELEVATION TOP OF HOLE: 3.383 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: N/A %
9. TOTAL DEPTH OF HOLE: 12.0 Ft.	19. SIGNATURE OF ENGINEER: Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
3.4	.0					3.4
.4	3.0		FILL consisting of CLAY with little silt, stiff, brown to orange-brown, some root fragments. (CL)		1	BACKHOE .4
-3.6	7.0		FILL-Wood and construction debris consisting of scrap metal and concrete fragments in a clayey sand matrix, black. -water percolated through this layer very fast.		2	BACKHOE -3.6
-8.6	12.0		SAND with trace silt and trace construction debris, well graded beach sand, gray to black. (SW)		3	BACKHOE -8.6
			END OF TEST PIT TP-MP98-03 AT 12.0 FEET DEPTH. NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System.			

Scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Martin Pena Project, San Juan, P.R. — HOLE NUMBER: TP-MP98-03

Hole No. TP-MP98-04

DRILLING LOG

DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 1
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=630,001 Y=218,682	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. (As shown on drawing title and file number): TP-MP98-04	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 4 undisturbed: 0
5. NAME OF DRILLER: GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES: 0
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: -2.363 Ft.
	16. DATE HOLE: STARTED 04/28/98 COMPLETED 04/28/98
7. THICKNESS OF BURDEN: 11.0 Ft.	17. ELEVATION TOP OF HOLE: 4.137 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: N/A %
9. TOTAL DEPTH OF HOLE: 11.0 Ft.	19. SIGNATURE OF ENGINEER: Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
4.1	.0					4.1
2.1	2.0		Silty CLAY soil with some gravel and trace sand, dark brown; some root fragments. (CL)		1	BACKHOE 2.1
1.1	3.0		CLAY, with some gravel and little silt, reddish brown; some construction debris. (CH)		2	BACKHOE 1.1
-5.9	10.0		Organic sandy SILT with little gravel, high organic content and strong organic odor, high content of wood fragments, garbage and some construction debris (blocks, tubes, etc.) (OL)		3	BACKHOE -5.9
-6.9	11.0		Silty SAND with trace gravel, gray colored (probably a sand lens). (SM)		4	BACKHOE -6.9
			END OF TEST PIT TP-MP98-04 AT 11.0 FEET DEPTH.			
			NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System.			

Scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No. TP-MP98-05

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 1

1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=630,153 Y=219,014	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. (As shown on drawing title and file number): TP-MP98-05	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 4 undisturbed: 0
5. NAME OF DRILLER: GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES: 0
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: −0.425 Ft.
	16. DATE HOLE: STARTED 05/05/98 COMPLETED 05/05/98
7. THICKNESS OF BURDEN: 9.0 Ft.	17. ELEVATION TOP OF HOLE: 3.075 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: N/A %
9. TOTAL DEPTH OF HOLE: 9.0 Ft.	19. SIGNATURE OF ENGINEER: Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
3.1	.0					3.1
2.1	1.0		FILL consisting of sandy GRAVEL with little silt, gray.		1	BACKHOE 2.1
-.4	3.5		FILL consisting of silty CLAY with some gravel and construction debris consisting of concrete and steel rods; reddish brown; there is a house foundation at the bottom of the unit. (CL)		2	BACKHOE -.4
-4.4	7.5		Trash and construction debris consisting of tires, plastics, wood debris, concrete fragments scrap metal and gravel, all in a sandy silt matrix with high organic content, black; water percolates into the pit only through this layer.		3	BACKHOE -4.4
-5.9	9.0		PEAT with some gray clay lenses and little trash, fibrous, very soft, black to dark brown. (Pt)		4	BACKHOE -5.9
			END OF TEST PIT TP-MP98-05 AT 9.0 FEET DEPTH. NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System.			

Scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT	HOLE NUMBER
Martin Pena Project, San Juan, P.R.	TP-MP98-05

Hole No.TP-MP98-06

DRILLING LOG DIVISION South Atlantic	INSTALLATION Jacksonville District — SHEET 1 OF 1
1. PROJECT Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT See Remarks
2. LOCATION (Coordinates or Station) X=630,311 Y=218,825	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. (As shown on drawing title and file number) TP-MP98-06	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 3 undisturbed: 0
5. NAME OF DRILLER GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES 0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER −2.437 Ft.
	16. DATE HOLE STARTED 04/28/98 COMPLETED 04/28/98
7. THICKNESS OF BURDEN 12.0 Ft.	17. ELEVATION TOP OF HOLE 3.535 Ft.
8. DEPTH DRILLED INTO ROCK 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 12.0 Ft.	19. SIGNATURE OF ENGINEER Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
3.5	.0					3.5
.5	3.0		FILL, consisting of silty CLAY with some gravel, gravel ranged from 3cm-30cm; little construction debris. (CL)		1	BACKHOE
-6.5	10.0		Construction debris consisting of wood fragments, bricks, blocks, concrete.		2	.5 BACKHOE
-8.5	12.0		PEAT, very soft, fibrous, dark brown to black. (Pt)		3	-6.5 BACKHOE
			END OF TEST PIT TP-MP98-06 AT 12.0 FEET DEPTH. NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System.			-8.5

Scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT Martin Pena Project, San Juan, P.R. | HOLE NUMBER TP-MP98-06

Hole No. TP-MP98-07

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 1

1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=630,436 Y=219,026	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. (As shown on drawing title and file number): TP-MP98-07	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 3 undisturbed: 0
5. NAME OF DRILLER: GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES: 0
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 05/05/98 COMPLETED 05/05/98
7. THICKNESS OF BURDEN: 11.0 Ft.	17. ELEVATION TOP OF HOLE: 2.211 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: N/A %
9. TOTAL DEPTH OF HOLE: 11.0 Ft.	19. SIGNATURE OF ENGINEER: Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
2.2	.0					2.2
1.2	1.0		FILL consisting of clay with some gravel and cobbles, reddish brown. (CL)		1	BACKHOE 1.2
-1.3	3.5		FILL consisting of clayey SILT with some sand and little gravel, brown to green, it contains little construction debris and some debris. (ML)		2	BACKHOE -1.3
-8.8	11.0		PEAT with some organic clay and little gravel and sand, very soft, fibrous, strong organic odor, dark brown to black; water percolates from the bottom of test pit. (Pt)		3	BACKHOE -8.8
			END OF TEST PIT TP-MP98-07 AT 11.0 FEET DEPTH. NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System. Groundwater level was not recorded.			

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.TP-MP98-08

DRILLING LOG DIVISION South Atlantic	INSTALLATION Jacksonville District — SHEET 1 OF 1
1. PROJECT Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT See Remarks
2. LOCATION *(Coordinates or Station)* X=630,729 Y=218,410	11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)* MSL
3. DRILLING AGENCY GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. *(As shown on drawing title and file number)* TP-MP98-08	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 4 undisturbed: 0
5. NAME OF DRILLER GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES 0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER
	16. DATE HOLE STARTED 05/05/98 COMPLETED 05/05/98
7. THICKNESS OF BURDEN 12.0 Ft.	17. ELEVATION TOP OF HOLE 3.064 Ft.
8. DEPTH DRILLED INTO ROCK 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 12.0 Ft.	19. SIGNATURE OF ENGINEER Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
3.1	.0					3.1
2.1	1.0		FILL consisting of gravel with some clay and silt, brown. (GC)		1	BACKHOE 2.1
-.9	4.0		FILL consisting of clay with some gravel, some construction debris and scrap metal, reddish brown to brown. (CL)		2	BACKHOE -.9
-6.9	10.0		Trash consisting of household items such as plastic, plastic bottles, textiles, wires, wood and some construction debris, all in a clayey silt matrix, black; strong organic odor. -water percolates very fast from this layer.		3	BACKHOE -6.9
-8.9	12.0		CLAY with some to little sand, stiff, olive green, brown, little organic matter. (CL)		4	BACKHOE -8.9
			END OF TEST PIT TP-MP98-08 AT 12.0 FEET DEPTH. NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System.			

Scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT Martin Pena Project, San Juan, P.R. | HOLE NUMBER TP-MP98-08

Hole No.TP-MP98-09

DRILLING LOG

DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 1
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=630,592 Y=218,235	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. (As shown on drawing title and file number): TP-MP98-09	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 4 undisturbed: 0
5. NAME OF DRILLER: GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES: 0
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 04/28/98 COMPLETED 04/28/98
7. THICKNESS OF BURDEN: 10.0 Ft.	17. ELEVATION TOP OF HOLE: 2.616 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: N/A %
9. TOTAL DEPTH OF HOLE: 10.0 Ft.	19. SIGNATURE OF ENGINEER: Jorge R. Parra, P.E. JRP

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
2.6	.0					2.6
-.4	3.0		FILL, consisting of silty CLAY with some gravel and little sand, brown, gravel is coarse with some cobble sized clasts, trace construction debris. (CL)		1	BACKHOE -.4
-2.4	5.0		FILL-GRAVEL and cobbles with some clay and organic matter, stong organic odor, trace construction debris. (GC)		2	BACKHOE -2.4
-6.4	9.0		FILL, construction debris, trash and cobble sized gravel.		3	BACKHOE -6.4
-7.4	10.0		PEAT, very soft, fibrous, dark brown to gray. (Pt)		4	BACKHOE -7.4

END OF TEST PIT TP-MP98-09 AT 10.0 FEET DEPTH.

NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System.

Groundwater level was not recorded.

Scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

DRILLING LOG

DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 1
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=630,834 Y=217,868	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. (As shown on drawing title and file number): TP-MP98-10	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 3 undisturbed: 0
5. NAME OF DRILLER: GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES: 0
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 04/28/98 COMPLETED 04/28/98
7. THICKNESS OF BURDEN: 10.0 Ft.	17. ELEVATION TOP OF HOLE: 3.544 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: N/A %
9. TOTAL DEPTH OF HOLE: 10.0 Ft.	19. SIGNATURE OF ENGINEER: Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
3.5	.0					3.5
.5	3.0		FILL-consisting of silty CLAY with some construction debris, reddish brown. (CL)		1	BACKHOE .5
-1.5	5.0		FILL-consisting of GRAVEL and cobbles with some silt, olive green; little construction debris. (GW)		2	BACKHOE -1.5
-6.5	10.0		FILL-Construction debris with little trash, some organic clay and peat, little gravel, black, strong organic odor.		3	BACKHOE -6.5
			END OF TEST PIT TP-MP98-10 AT 10.0 FEET DEPTH. NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System. Groundwater level was not recorded.			

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.TP-MP98-11

DRILLING LOG — DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 1
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=631,222 Y=217,761	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. (As shown on drawing title and file number): TP-MP98-11	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 4 undisturbed: 0
5. NAME OF DRILLER: ENGR. JORGE R. PARRA	14. TOTAL NUMBER OF CORE BOXES: 0
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: -1.076 Ft.
	16. DATE HOLE: STARTED 05/01/98 COMPLETED 05/01/98
7. THICKNESS OF BURDEN: 11.0 Ft.	17. ELEVATION TOP OF HOLE: 2.924 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: N/A %
9. TOTAL DEPTH OF HOLE: 11.0 Ft.	19. SIGNATURE OF ENGINEER: Jorge R. Parra, P.E. JRP

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
2.9	.0					2.9
-2.1	5.0		FILL, reddish brown CLAY, mixed with little gravel and sand, garbage found in the upper 1-foot depth (glass, cloth, plastic)		1	BACKHOE -2.1
-3.1	6.0		Garbage (wood, glass jars, plastic, debris)		2	BACKHOE -3.1
-4.1	7.0		PEAT, fibrous, little silt, wood fragments, black. (Pt)		3	BACKHOE -4.1
-8.1	11.0		SAND, trace silt, light brown, collapsable, rapid infiltration of groundwater. (SP)		4	BACKHOE -8.1
			END OF TEST PIT NO. TP-MP98-11 AT 11.0 FEET DEPTH. NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System.			

Scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No. TP-MP98-12

DRILLING LOG — DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 1
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=631,494 Y=218,072	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. (As shown on drawing title and file number): TP-MP98-12	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 5 undisturbed: 0
5. NAME OF DRILLER: ENGR. JORGE R. PARRA	14. TOTAL NUMBER OF CORE BOXES: 0
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: −0.698 Ft.
	16. DATE HOLE: STARTED 05/01/98 COMPLETED 05/01/98
7. THICKNESS OF BURDEN: 10.5 Ft.	17. ELEVATION TOP OF HOLE: 2.302 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: N/A %
9. TOTAL DEPTH OF HOLE: 10.5 Ft.	19. SIGNATURE OF ENGINEER: Jorge R. Parra, P.E. JRP

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
2.3	.0					2.3
.3	2.0		FILL-SAND and construction debris (concrete block fragments, tile, plastics), reddish brown.		1	BACKHOE .3
-2.7	5.0		FILL-Garbage (tree trunks, telephone poles, cloth, glass), black, strong chemical odors.		2	BACKHOE -2.7
-4.2	6.5		PEAT, fibrous, little to some silt, very soft, black. (Pt)		3	BACKHOE -4.2
-4.7	7.0		Silty SAND pocket, brown. (SM)		4	-4.7 BACKHOE
-8.2	10.5		CLAY, some silt, light gray. (CH)		5	BACKHOE -8.2
			END OF TEST PIT NO. TP-MP98-12 AT 10.5 FEET DEPTH. NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System.			

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.TP-MP98-13

DRILLING LOG	DIVISION: South Atlantic
INSTALLATION: Jacksonville District	SHEET 1 OF 1
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=631,384 Y=218,372	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. (As shown on drawing title and file number): TP-MP98-13	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 5 undisturbed: 0
5. NAME OF DRILLER: GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES: 0
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER:
	16. DATE HOLE: STARTED 05/07/98 COMPLETED 05/07/98
7. THICKNESS OF BURDEN: 12.0 Ft.	17. ELEVATION TOP OF HOLE: 2.148 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: N/A %
9. TOTAL DEPTH OF HOLE: 12.0 Ft.	19. SIGNATURE OF ENGINEER: Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
2.1	.0					2.1
.6	1.5		FILL consisting of CLAY with some gravel, stiff, brown to reddish brown; little construction debris consisting of concrete fragments. (CL)		1	BACKHOE .6
-.4	2.5		FILL consisting of gravelly SAND, dense, gray. (SW)		2	BACKHOE -.4
-6.9	9.0		FILL-Construction debris consisting of concrete fragments with little scrap metal, little wood fragments and trace tires.		3	BACKHOE -6.9
-8.9	11.0		PEAT with some organic cal and some shell fragments, fibrous, very soft, brown to dark brown. (Pt)		4	BACKHOE -8.9
-9.9	12.0		CLAY with trace sand, stiff, gray to pale gray to pale brown. (CH)		5	BACKHOE -9.9
			END OF TEST PIT TP-MP98-13 AT 12.0 FEET DEPTH.			

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System.

Groundwater level was not recorded.

Hole No.TP-MP98-14

DRILLING LOG DIVISION South Atlantic	INSTALLATION Jacksonville District SHEET 1 OF 1
1. PROJECT Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT See Remarks
2. LOCATION (Coordinates or Station) X=631,871 Y=218,574	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. (As shown on drawing title and file number) TP-MP98-14	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 3 undisturbed: 0
5. NAME OF DRILLER GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES 0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER -1.159 Ft.
	16. DATE HOLE STARTED 05/06/98 COMPLETED 05/06/98
7. THICKNESS OF BURDEN 12.0 Ft.	17. ELEVATION TOP OF HOLE 1.841 Ft.
8. DEPTH DRILLED INTO ROCK 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 12.0 Ft.	19. SIGNATURE OF ENGINEER Jorge R. Parra, P.E. JRP

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
1.8	.0					1.8
-.7	2.5		FILL consisting of CLAY with some sand and gravel, some construction debris consisting of concrete, wood fragments and scrap metal, brown to orange brown. (CL)		1	BACKHOE -.7
-9.2	11.0		FILL-Construction debris and trash consisting of wood fragments, concrete, scrap metals, plastics, pieces of cloth all in an n organic clay matrix, black.		2	BACKHOE -9.2
-10.2	12.0		CLAY with some sand, stiff, gray. (CH)		3	BACKHOE -10.2
			END OF TEST PIT TP-MP98-14 AT 12.0 FEET DEPTH. NOTES: Test Pit was relocated 15 ft. Eastward. Soils are field visually classified in accordance with the Unified Soils Classification System.			

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT	HOLE NUMBER
Martin Pena Project, San Juan, P.R.	TP-MP98-14

Hole No.TP-MP98-15

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 1

1. PROJECT Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT See Remarks
2. LOCATION *(Coordinates or Station)* X=631,711 Y=218,467	11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)* MSL
3. DRILLING AGENCY GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. *(As shown on drawing title and file number)* TP-MP98-15	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 4 undisturbed: 0
5. NAME OF DRILLER GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES 0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER
	16. DATE HOLE STARTED 04/30/98 COMPLETED 04/30/98
7. THICKNESS OF BURDEN 12.00 Ft.	17. ELEVATION TOP OF HOLE 2.506 Ft.
8. DEPTH DRILLED INTO ROCK 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 12.0 Ft.	19. SIGNATURE OF ENGINEER Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
2.5	.0					2.5
1.5	1.0		SILT with some gravel and trace clay, some construction debris consisting of wood, tiles, block, briks and concrete. (ML)		1	BACKHOE 1.0
.0	2.5		Silty SAND with little construction debris, poorly graded, gray to olive green. (SM)		2	BACKHOE -.5
-2.0	4.5		Wood debris, garbage, tiles, block and gravel on a black clayey matrix with a high organic content; water filtrates into the trench only through this layer.		3	BACKHOE -2.5
-9.5	12.0		Dark brown organic SILT with some sand, high quantity of numerous kinds of debris (garbage, scrap metal, construction debris, etc) some high plasticity clay lenses, gray to olive green- brown. (OL)		4	BACKHOE -9.5
			END OF TEST PIT TP-MP98-15 AT 12.00 FEET DEPTH. NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System.			

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT	HOLE NUMBER
Martin Pena Project, San Juan, P.R.	TP-MP98-15

Hole No.TP-MP98-16

DRILLING LOG

DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 1
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=632,326 Y=218,005	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. (As shown on drawing title and file number): TP-MP98-16	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 3 undisturbed: 0
5. NAME OF DRILLER: ENGR. JORGE R. PARRA	14. TOTAL NUMBER OF CORE BOXES: 0
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: -0.379 Ft.
	16. DATE HOLE: STARTED 05/01/98 COMPLETED 05/01/98
7. THICKNESS OF BURDEN: 9.0 Ft.	17. ELEVATION TOP OF HOLE: 1.621 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: N/A %
9. TOTAL DEPTH OF HOLE: 9.0 Ft.	19. SIGNATURE OF ENGINEER: Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
1.6	.0					1.6
.6	1.0		FILL-CLAY, reddish brown. (CH)		1	BACKHOE .6
-5.4	7.0		FILL-brick fragments and wood fragments, dark gray.		2	BACKHOE -5.4
-7.4	9.0		Organic SILT, little peat, soft, black. (OL)		3	BACKHOE -7.4
			END OF TEST PIT NO. TP-MP98-16 AT 9.0 FEET DEPTH. NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System.			

Scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.TP-MP98-17

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 1

1. PROJECT Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT See Remarks
2. LOCATION *(Coordinates or Station)* X=632,511 Y=218,169	11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)* MSL
3. DRILLING AGENCY GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. *(As shown on drawing title and file number)* TP-MP98-17	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 3 undisturbed: 0
5. NAME OF DRILLER GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES 0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER −0.982 Ft.
7. THICKNESS OF BURDEN 12.0 Ft.	16. DATE HOLE STARTED 05/06/98 COMPLETED 05/06/98
8. DEPTH DRILLED INTO ROCK 0 Ft.	17. ELEVATION TOP OF HOLE 2.018 Ft.
9. TOTAL DEPTH OF HOLE 12.0 Ft.	18. TOTAL CORE RECOVERY FOR BORING N/A %
	19. SIGNATURE OF ENGINEER Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
2.0	.0					2.0
			FILL consisting of sandy SILT with some scrap metal, concrete fragments and wood fragments, brown to mint green; some raw sewage. (ML)		1	BACKHOE
-1.5	3.5					-1.5
			FILL-Construction debris with some trash consisting of wood fragmeents, concrete fragments, plastic, tires, scrap metals, all in an organic clay matrix, black.		2	BACKHOE
-9.0	11.0					-9.0
			PEAT with some organic clay, very soft, fibrous, black. (Pt)		3	BACKHOE
-10.0	12.0					-10.0
			END OF TEST PIT TP-MP98-17 AT 12.0 FEET DEPTH. NOTES: Soils are field visually classified in accordance with the Unified Soils Classification System. This test pit was relocated 35 feet in the nortwest direction along the wall alignment.			

Scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

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PROJECT	HOLE NUMBER
Martin Pena Project, San Juan, P.R.	TP-MP98-17

Hole No.TP-MP98-18

DRILLING LOG

DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 1
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=632,689 Y=217,713	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. (As shown on drawing title and file number): TP-MP98-18	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 3 undisturbed: 0
5. NAME OF DRILLER: GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES: 0
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: 0.62 Ft.
	16. DATE HOLE: STARTED 05/04/98 COMPLETED 05/04/98
7. THICKNESS OF BURDEN: 12.0 Ft.	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: N/A
9. TOTAL DEPTH OF HOLE: 12.0 Ft.	19. SIGNATURE OF ENGINEER: Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
n/a	.0					
	2.5		FILL consisting of CLAY with some silt and little gravel, little trash consisting of plastics and bottles, brown to dark brown. (CL)		1	BACKHOE
	10.0		FILL-Construction debris consisting of concrete slabs and some wood fragments, some trash and garbage consisting of tires and plastics, all in silty and sandy matrix with high organic content.		2	BACKHOE
	12.0		PEAT with little organic clay, fibrous, strong organic odor, black, some shell fragments. (Pt)		3	BACKHOE
			END OF TEST PIT NO. TP-MP98-18 AT 12.0 FEET DEPTH. NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System.			

Scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No. TP-MP98-19

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 1

1. PROJECT Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT See Remarks
2. LOCATION (Coordinates or Station) X=633,277 Y=217,748	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. (As shown on drawing title and file number) TP-MP98-19	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 2 undisturbed: 0
5. NAME OF DRILLER GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES 0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER -2.566 Ft.
	16. DATE HOLE STARTED 05/06/98 COMPLETED 05/06/98
7. THICKNESS OF BURDEN 9.0 Ft.	17. ELEVATION TOP OF HOLE 2.434 Ft.
8. DEPTH DRILLED INTO ROCK 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 9.0 Ft.	19. SIGNATURE OF ENGINEER Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
2.4	.0					2.4
			FILL consisting of SAND with some gravel, little clay and construction debris consisting of concrete, wood fragments and scrap metal, pale brown. (SW)		1	BACKHOE
-2.6	5.0					-2.6
			Construction debris and trash consisting of concrete fragments, wood, plastics, tiles fragments, scrap metal and tree trunks, all in a sandy clay matrix with high organic content and strong odor.		2	BACKHOE
-6.6	9.0					-6.6
			END OF TEST PIT TP-MP98-19 AT 9.0 FEET DEPTH. NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System.			

Scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.TP-MP98-20

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 1

1. PROJECT Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT See Remarks
2. LOCATION *(Coordinates or Station)* X=633,195 Y=217,553	11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)* MSL
3. DRILLING AGENCY GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. *(As shown on drawing title and file number)* TP-MP98-20	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 4 undisturbed: 0
5. NAME OF DRILLER GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES 0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER
	16. DATE HOLE STARTED 05/04/98 COMPLETED 05/04/98
7. THICKNESS OF BURDEN 12.0 Ft.	17. ELEVATION TOP OF HOLE 3.305 Ft.
8. DEPTH DRILLED INTO ROCK 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 12.0 Ft.	19. SIGNATURE OF ENGINEER Jorge R. Parra, P.E. JRP

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
3.3	.0					3.3
2.3	1.0		FILL consisting of gravelly SILT with some sand and construction debris, dark brown. (ML)		1	BACKHOE 2.3
.8	2.5		FILL consisting of gravelly CLAY with some construction debris and scrap metal, reddish brown. (CL)		2	BACKHOE .8
-6.7	10.0		FILL-Construction debris consisting of concrete slab fragments, wood debris, scrap metal, wires and fences, and trash (tires and plastics); all in a black sandy-silty matrix. -Water flowed into the pit through this layer.		3	BACKHOE -6.7
-8.7	12.0		PEAT with little organic clay, fibrous, strong organic odor, black. (Pt)		4	BACKHOE -8.7
			END OF TEST PIT NO. TP-MP98-20 AT 12.0 FEET DEPTH. NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System.			

Scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

DRILLING LOG

DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 1
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=633,640 Y=217,391	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. (As shown on drawing title and file number): TP-MP98-21	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 3 undisturbed: 0
5. NAME OF DRILLER: GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES: 0
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: Ft.
	16. DATE HOLE: STARTED 05/06/98 COMPLETED 05/06/98
7. THICKNESS OF BURDEN: 12.0 Ft.	17. ELEVATION TOP OF HOLE: 1.511 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: N/A %
9. TOTAL DEPTH OF HOLE: 12.0 Ft.	19. SIGNATURE OF ENGINEER: Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
1.5	.0					1.5
-1.5	3.0		FILL consisting of silty CLAY with some gravel, construction debris and scrap metal, brown. (CL)		1	BACKHOE -1.5
-5.5	7.0		Construction debris and trash consisting of concrete fragments, wood fragments, scrap metal, plastics and tires, all in a sandy clay matrix with high organic content and strong odors. -water percolates into the trench only through this layer.		2	BACKHOE -5.5
-10.5	12.0		PEAT with some organic clay, fibrous, very soft, strong organic odor, black. (Pt)		3	BACKHOE -10.5
			END OF TEST PIT TP-MP98-21 AT 12.0 FEET DEPTH. NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System.			

Scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.TP-MP98-22

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 1

1. PROJECT Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT See Remarks
2. LOCATION (Coordinates or Station) X=633,608 Y=217,134	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. (As shown on drawing title and file number) TP-MP98-22	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 5 undisturbed: 0
5. NAME OF DRILLER GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES 0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER ft.
	16. DATE HOLE STARTED 04/30/98 COMPLETED 04/30/98
7. THICKNESS OF BURDEN 12.00 Ft.	17. ELEVATION TOP OF HOLE 2.272 Ft.
8. DEPTH DRILLED INTO ROCK 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 12.0 Ft.	19. SIGNATURE OF ENGINEER Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
2.3	.0					2.3
1.3	1.0		FILL consisting of gray colored gravelly SILT with some sand and lenses of orange-brown gravelly clay, some construction debris. (GM)		1	BACKHOE .8
-.7	3.0		Organic CLAY with some decomposing organic material, trash, wood fragments, strong organic odor, black to dark brown. (OH)		2	BACKHOE -.7
-2.7	5.0		Gravelly CLAY, olive green. (CH)		3	BACKHOE -2.7
-8.2	10.5		PEAT with some to little organic clay, very soft, fibrous, strong organic odor. (Pt)		4	BACKHOE -8.2
-9.7	12.0		CLAY with trace sand, olive green to brown; some decomposing plant and wood fragments. (CH)		5	BACKHOE -9.7

END OF TEST PIT TP-MP98-22 AT 12.00 FEET DEPTH.

NOTE: Underneath 5 feet of fill consisting of construction debris; a refrigerator, scrap metal and gravel with clay and silt, we found a concrete slab so we decided to move the Test Pit 8 m. toward Martin Pena Channel.

Soils are field visually classified in accordance with the Unified Soils Classification System.

Groundwater level was not recorded.

Scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No. TP-MP98-24

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	SHEET 1 OF 1

1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=634,151 Y=216,995	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. (As shown on drawing title and file number): TP-MP98-24	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 2 undisturbed: 0
5. NAME OF DRILLER: GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES: 0
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: -2.99 Ft.
	16. DATE HOLE: STARTED 05/13/98 COMPLETED 05/13/98
7. THICKNESS OF BURDEN: 10.0 Ft.	17. ELEVATION TOP OF HOLE: 2.010 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: N/A %
9. TOTAL DEPTH OF HOLE: 10.0 Ft.	19. SIGNATURE OF ENGINEER: Jorge R. Parra, P.E. JRP

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
2.0	.0					2.0
.0	2.0		FILL-Sandy Clay, some gravel and construction debris consisting of concrete, wood, scrap metal, dark brown. (CL)		1	BACKHOE .0
-8.0	10.0		Construction debris and trash consisting of concrete fragments and wood fragments, scrap metal, and plastics, all in a organic clay matrix, black.		2	BACKHOE -8.0
			END OF TEST PIT TP-MP98-24 AT 10.0 FEET DEPTH. NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System.			

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.TP-MP98-25

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 1
1. PROJECT Martin Pena Project, San Juan, P.R.		10. SIZE AND TYPE OF BIT See Remarks	
2. LOCATION (Coordinates or Station) X=634,399 Y=217,138		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY GEO CIM, INC.		12. MANUFACTURER'S DESIGNATION OF DRILL TEST PIT EXCAVATED WITH BACKHOE	
4. HOLE NO. (As shown on drawing title and file number) TP-MP98-25		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 2 undisturbed: 0	
5. NAME OF DRILLER GEOL. WILFREDO ROSADO		14. TOTAL NUMBER OF CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED		15. ELEVATION GROUND WATER 0.226 Ft.	
		16. DATE HOLE STARTED 05/08/98 COMPLETED 05/08/98	
7. THICKNESS OF BURDEN 10.0 Ft.		17. ELEVATION TOP OF HOLE 3.226 Ft.	
8. DEPTH DRILLED INTO ROCK 0 Ft.		18. TOTAL CORE RECOVERY FOR BORING N/A %	
9. TOTAL DEPTH OF HOLE 10.0 Ft.		19. SIGNATURE OF ENGINEER Jorge R. Parra, P.E. JRP	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
3.2	.0					3.2
			FILL consisting of gravelly SAND with some clay and construction debris consisting of concrete fragments and scrap metal, brown. (SC)		1	BACKHOE
.2	3.0					.2
			Construction debris and trash consisting of concrete fragments, wood fragments, scrap metal, plastic, cloth and glass fragments, all in a organic clay matrix, black. -water level was found at the beginning of this layer.		2	BACKHOE
-6.8	10.0					-6.8
			END OF TEST PIT TP-MP98-25 AT 10.0 FEET DEPTH. NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System.			

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.TP-MP98-29

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 1
1. PROJECT Martin Pena Project, San Juan, P.R.		10. SIZE AND TYPE OF BIT See Remarks	
2. LOCATION (Coordinates or Station) X=635,331 Y=217,261		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY GEO CIM, INC.		12. MANUFACTURER'S DESIGNATION OF DRILL TEST PIT EXCAVATED WITH BACKHOE	
4. HOLE NO. (As shown on drawing title and file number) TP-MP98-29		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 2 undisturbed: 0	
5. NAME OF DRILLER GEOL. WILFREDO ROSADO		14. TOTAL NUMBER OF CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED		15. ELEVATION GROUND WATER	
		16. DATE HOLE STARTED 05/08/98 COMPLETED 05/08/98	
7. THICKNESS OF BURDEN 11.0 Ft.		17. ELEVATION TOP OF HOLE 2.265 Ft.	
8. DEPTH DRILLED INTO ROCK 0 Ft.		18. TOTAL CORE RECOVERY FOR BORING N/A %	
9. TOTAL DEPTH OF HOLE 11.0 Ft.		19. SIGNATURE OF ENGINEER Jorge R. Parra, P.E.	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
2.3	.0					2.3
-.7	3.0		FILL consisting of CLAY with some sand, some wood and concrete debris, brown. -at the bottom of this layer we encountered a 4-in. thick concrete slab.		1	BACKHOE -.7
-8.7	11.0		FILL-Construction debris consisting of wood fragments, concrete fragments, tires, scrap metal and trace household trash. -water quickly percolated through this layer.		2	BACKHOE -8.7
			END OF TEST PIT TP-MP98-29 AT 11.0 FEET DEPTH. NOTE: Soils are field visually classified in accordance with the Unified Soils Classification System.			

Depth scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

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PROJECT	HOLE NUMBER
Martin Pena Project, San Juan, P.R.	TP-MP98-29

Hole No.TP-MP98-30

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 1
1. PROJECT Martin Pena Project, San Juan, P.R.		10. SIZE AND TYPE OF BIT See Remarks	
2. LOCATION (Coordinates or Station) X=635,704 Y=216,696		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY GEO CIM, INC.		12. MANUFACTURER'S DESIGNATION OF DRILL TEST PIT EXCAVATED WITH BACKHOE	
4. HOLE NO. (As shown on drawing title and file number) TP-MP98-30		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 3 undisturbed: 0	
5. NAME OF DRILLER GEOL. WILFREDO ROSADO		14. TOTAL NUMBER OF CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED		15. ELEVATION GROUND WATER 0.841 Ft.	
		16. DATE HOLE STARTED 05/13/98 COMPLETED 05/13/98	
7. THICKNESS OF BURDEN 12.0 Ft.		17. ELEVATION TOP OF HOLE 0.841 Ft.	
8. DEPTH DRILLED INTO ROCK 0 Ft.		18. TOTAL CORE RECOVERY FOR BORING N/A %	
9. TOTAL DEPTH OF HOLE 12.0 Ft.		19. SIGNATURE OF ENGINEER Jorge R. Parra, P.E. JRP	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
.8	.0					.8
-.2	1.0		Vegetated mat.		1	BACKHOE -.2
-3.2	4.0		Household trash and wood debris all in an organic clay matrix, black.		2	BACKHOE -3.2
-11.2	12.0		Peat with organic clay and with shell fragments, fibrous, very soft. (Pt)		3	BACKHOE -11.2
			END OF TEST PIT TP-MP98-30 AT 12.0 FEET DEPTH. NOTES: Water was observed at surface level. Soils are field visually classified in accordance with the Unified Soils Classification System.			

Scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.TP-MP98-31

DRILLING LOG — DIVISION: South Atlantic	INSTALLATION: Jacksonville District — SHEET 1 OF 1
1. PROJECT: Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT: See Remarks
2. LOCATION (Coordinates or Station): X=636,510 Y=216,982	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL: TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. (As shown on drawing title and file number): TP-MP98-31	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 2 undisturbed: 0
5. NAME OF DRILLER: GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES: 0
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER: 1.324 Ft.
	16. DATE HOLE: STARTED 05/12/98 COMPLETED 05/12/98
7. THICKNESS OF BURDEN: 12.0 Ft.	17. ELEVATION TOP OF HOLE: 1.324 Ft.
8. DEPTH DRILLED INTO ROCK: 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING: N/A %
9. TOTAL DEPTH OF HOLE: 12.0 Ft.	19. SIGNATURE OF ENGINEER: Jorge R. Parra, P.E.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
1.3	.0					1.3
			Construction debris and trash consisting of wood fragments, plastic, tires, concrete; all in an organic CLAY matrix, black.		1	BACKHOE
-7.7	9.0					-7.7
			Peat, fibrous, very soft, black. (Pt)		2	BACKHOE
-10.7	12.0					-10.7
			END OF TEST PIT TP-MP98-31 AT 12.0 FEET DEPTH. NOTES: Water was on surface level. Soils are field visually classified in accordance with the Unified Soils Classification System.			

Scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

Hole No.TP-MP98-32

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 1

1. PROJECT Martin Pena Project, San Juan, P.R.	10. SIZE AND TYPE OF BIT See Remarks
2. LOCATION (Coordinates or Station) X=636,642 Y=217,082	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY GEO CIM, INC.	12. MANUFACTURER'S DESIGNATION OF DRILL TEST PIT EXCAVATED WITH BACKHOE
4. HOLE NO. (As shown on drawing title and file number) TP-MP98-32	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 2 undisturbed: 0
5. NAME OF DRILLER GEOL. WILFREDO ROSADO	14. TOTAL NUMBER OF CORE BOXES 0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED	15. ELEVATION GROUND WATER 1.038 Ft.
	16. DATE HOLE STARTED 05/13/98 COMPLETED 05/13/98
7. THICKNESS OF BURDEN 12.0 Ft.	17. ELEVATION TOP OF HOLE 1.038 Ft.
8. DEPTH DRILLED INTO ROCK 0 Ft.	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 12.0 Ft.	19. SIGNATURE OF ENGINEER Jorge R. Parra, P.E. JRP

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
1.0	.0					1.0
			Construction debris and trash consisting of wood debris, concrete, tires, plastics, cloth, scrap metal; in an organic clay matrix, black.		1	BACKHOE
-10.0	11.0					-10.0
			Peat, little organic clay, fibrous, very soft, dark brown; little shell fragments. (Pt)		2	BACKHOE
-11.0	12.0					-11.0
			END OF TEST PIT TP-MP98-32 AT 12.0 FEET DEPTH. NOTES: Water level was observed on surface level. Soil are field visually classified in accordance with the Unified Soils Classification System.			

Scale: 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5

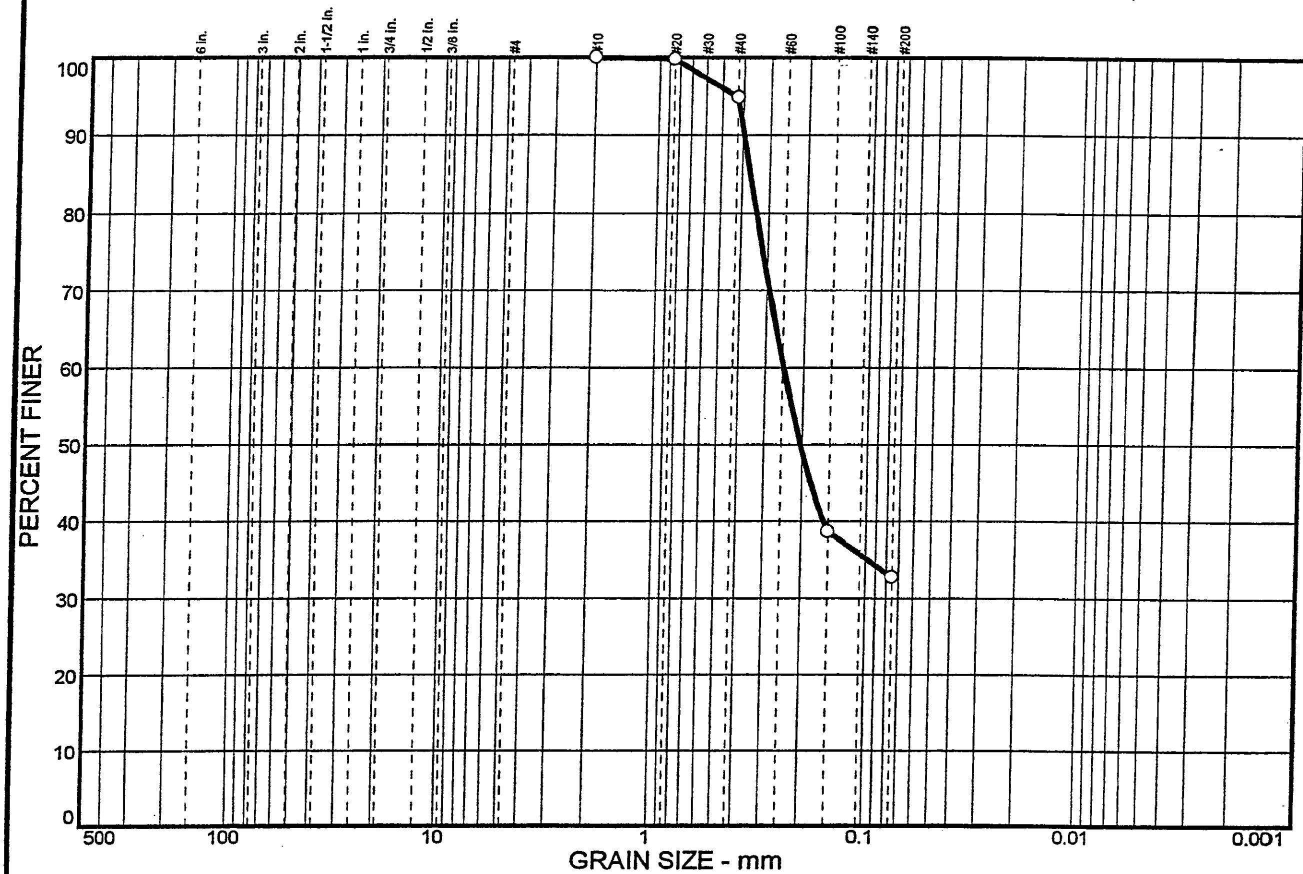
ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT	HOLE NUMBER
Martin Pena Project, San Juan, P.R.	TP-MP98-32

DREDGING OF CAÑO MARTÍN PEÑA
PUERTO RICO
FINAL
PROJECT DESIGN REPORT AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX B
GEOTECHNICAL INVESTIGATIONS
TEST REPORTS
BY GEO CIM, INC.

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	67.3	32.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.8		
#40	94.9		
#100	38.7		
#200	32.7		

* (no specification provided)

Soil Description

Brown SAND, some gray clay.

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.367 D_{60}= 0.246 D_{50}= 0.203
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SC AASHTO=

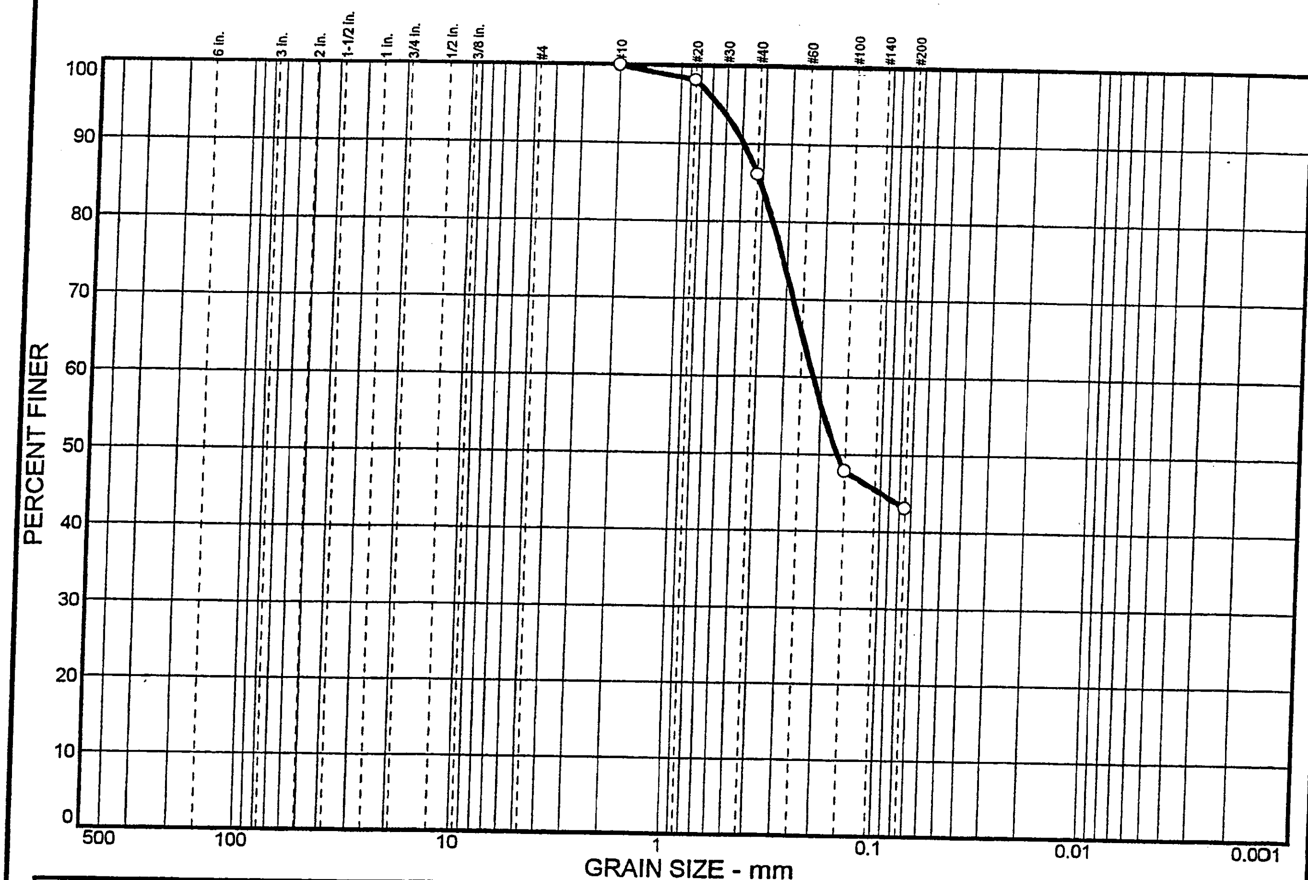
Remarks

Sample No.: 5-A **Source of Sample:** CB-MP98-1 **Date:** 5/29/98
Location: X=629285.463 Y=218943.188 **Elev./Depth:** 6.0' @ 7.5'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	56.9	43.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	98.2		
#40	86.1		
#100	47.9		
#200	43.1		

* (no specification provided)

Soil Description

Clayey Quartz SAND, gray.

Atterberg Limits

PL= 12.7 LL= 26.8 PI= 14.1

Coefficients

D_{85}= 0.410 D_{60}= 0.218 D_{50}= 0.163
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SC AASHTO=

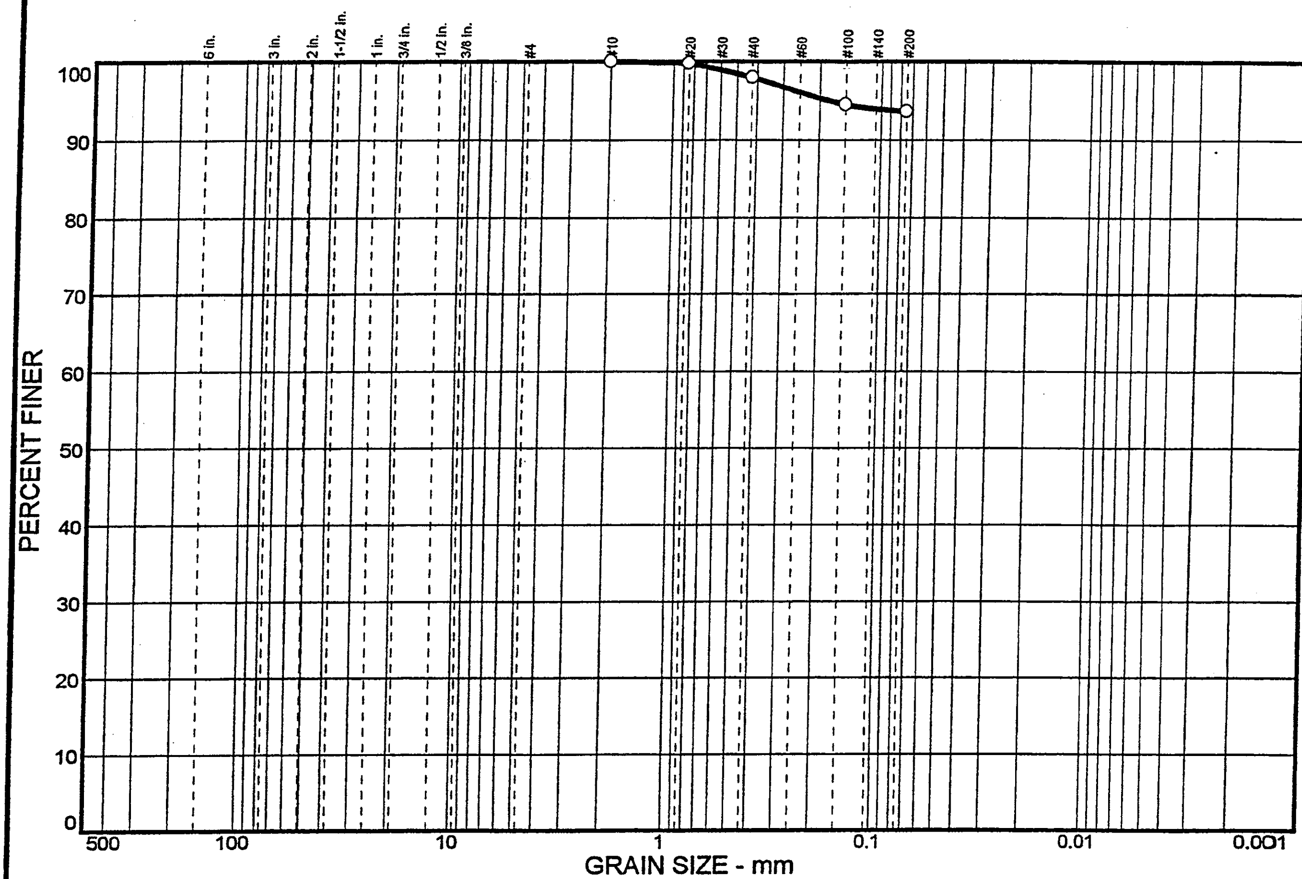
Remarks

Sample No.: 10-A **Source of Sample:** CB-MP98-1 **Date:** 5/29/98
Location: X=629285.463 Y=218943.188 **Elev./Depth:** 14.5' @ 16.0'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	6.4	93.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.8		
#40	98.0		
#100	94.5		
#200	93.6		

* (no specification provided)

Soil Description

CLAY,trace to little quartz sand, brown.

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

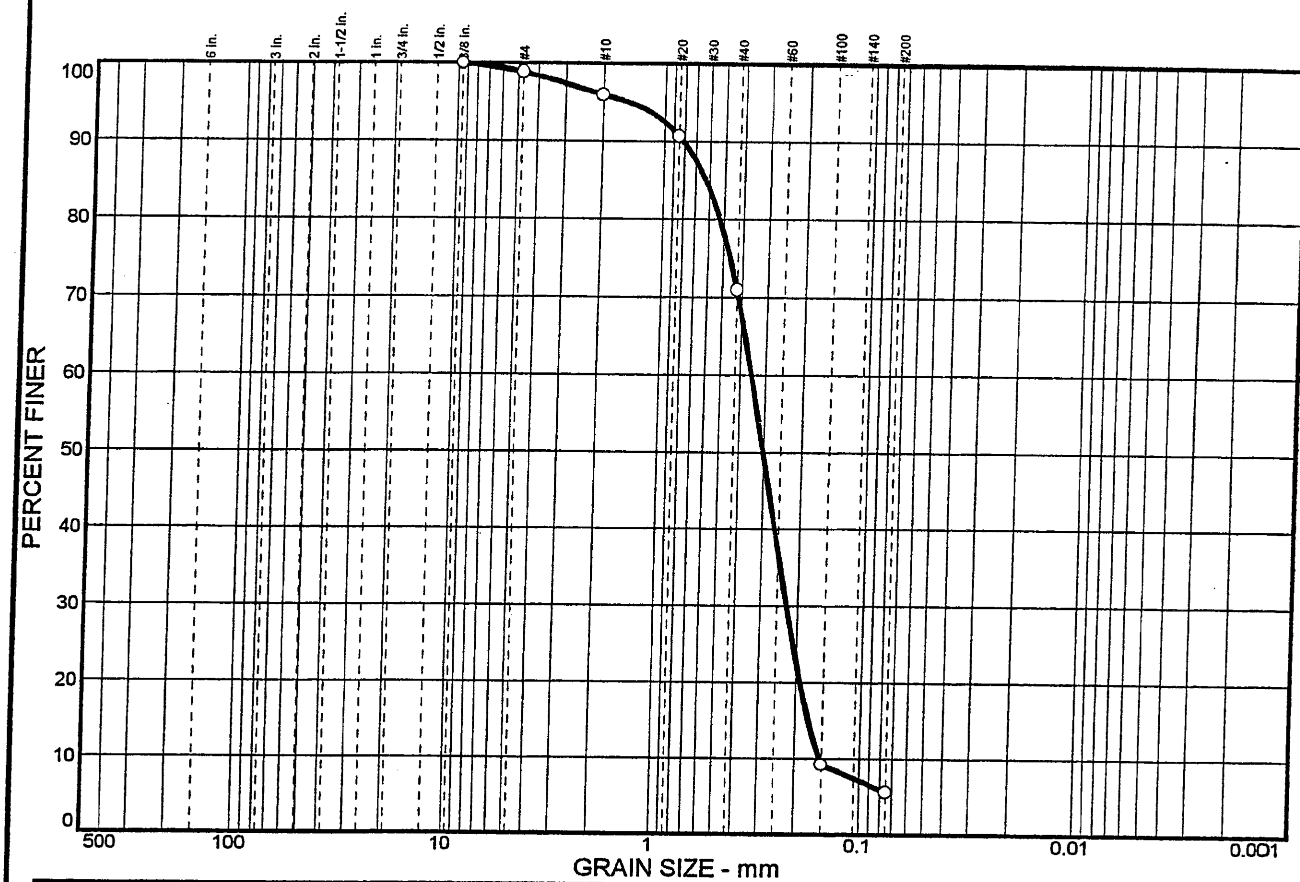
Remarks

Sample No.: 26-A **Source of Sample:** CB-MP98-1 **Date:** 5/29/98
Location: X=629285.463 Y=218943.188 **Elev./Depth:** 37.5' @ 39.0'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	1.1	93.3	5.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375 in.	100.0		
#4	98.9		
#10	96.0		
#20	90.7		
#40	71.0		
#100	9.2		
#200	5.6		

* (no specification provided)

Soil Description

SAND, trace silt and gravel, dark brown to black.

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.622 D_{60}= 0.351 D_{50}= 0.302

D_{30}= 0.225 D_{15}= 0.173 D_{10}= 0.154

C_u= 2.29 C_c= 0.94

Classification

USCS= SP-SM AASHTO=

Remarks

Sample No.: 8-A **Source of Sample:** CB-MP98-2 **Date:** 5/29/98

Location: X=629360.401 Y=218704.992 **Elev./Depth:** 10.5' @ 12.0'

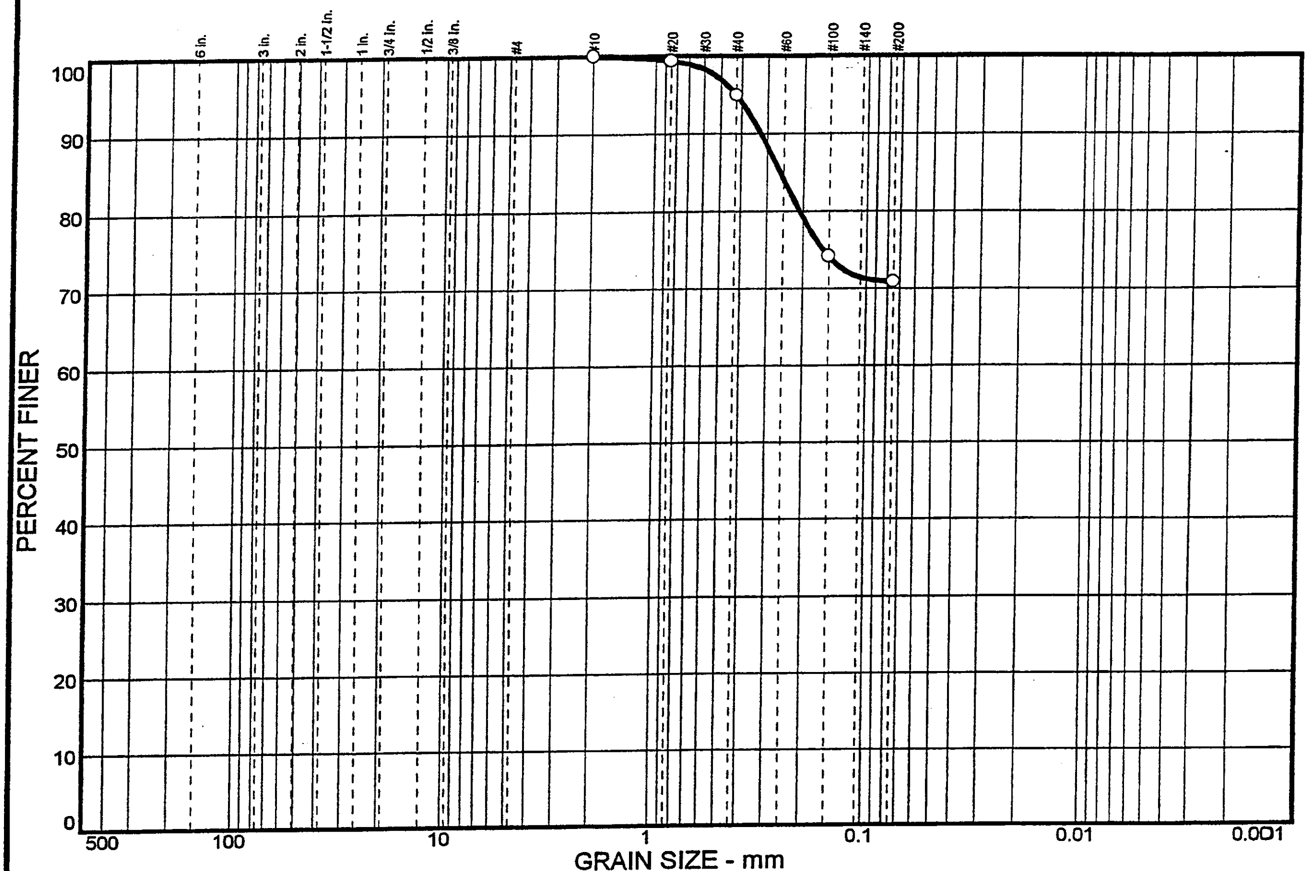
GEO CIM, INC.

Client: Corps of Engineer

Project: Martin Pena Project
San Juan, P.R.

Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	29.1	70.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.4		
#40	95.0		
#100	74.2		
#200	70.9		

* (no specification provided)

Soil Description

CLAY, some sand, gray.

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.259 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

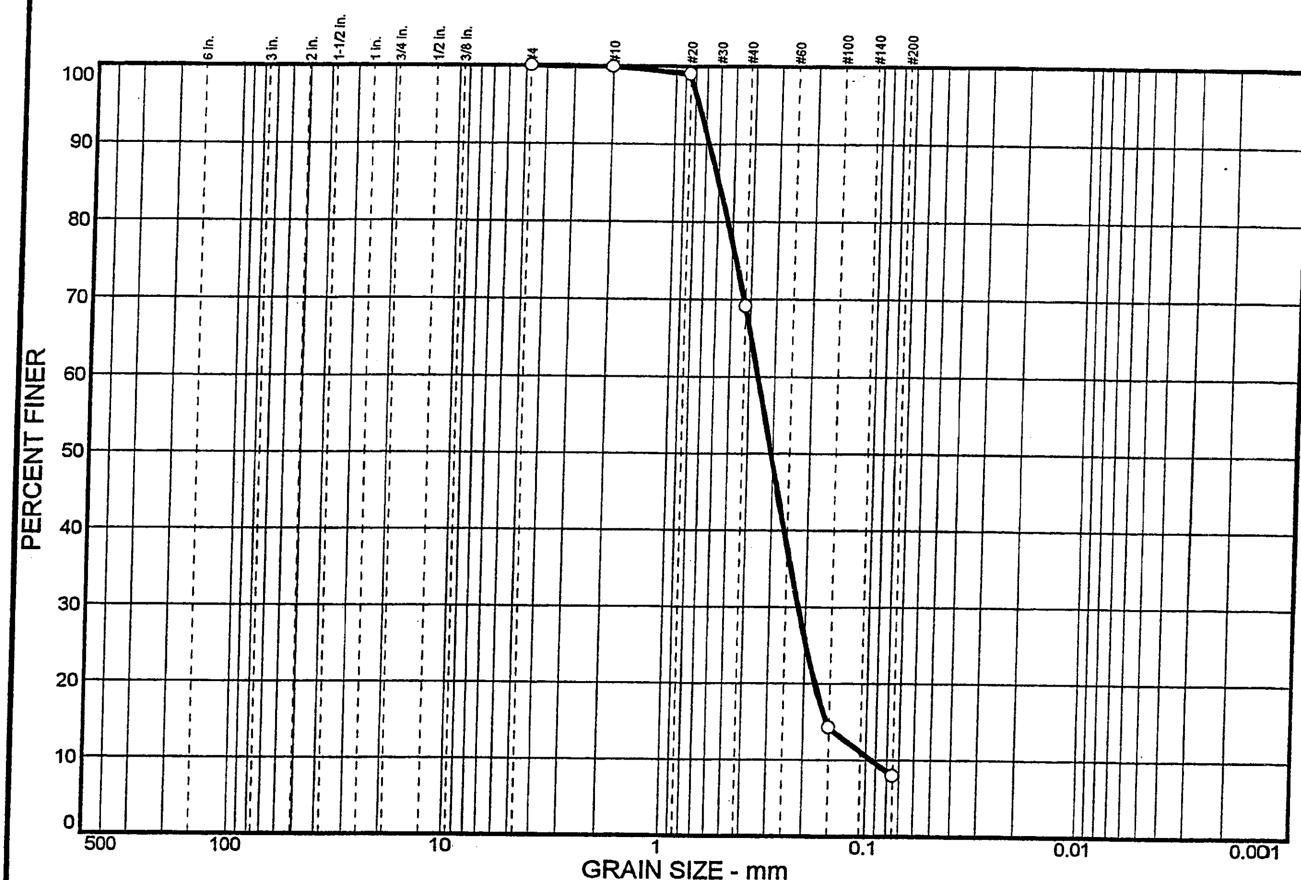
Remarks

Sample No.: 13-A **Source of Sample:** CB-MP98-2 **Date:** 5/29/98
Location: X=629360.401 Y=218704.992 **Elev./Depth:** 18.0' @ 19.5'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	92.1	7.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#20	99.0		
#40	69.1		
#100	14.2		
#200	7.9		

* (no specification provided)

Soil Description

SAND, trace silt, pale brown.

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.596 D_{60}= 0.361 D_{50}= 0.306
D_{30}= 0.217 D_{15}= 0.154 D_{10}= 0.0945
C_u= 3.82 C_c= 1.38

Classification

USCS= SP-SM AASHTO=

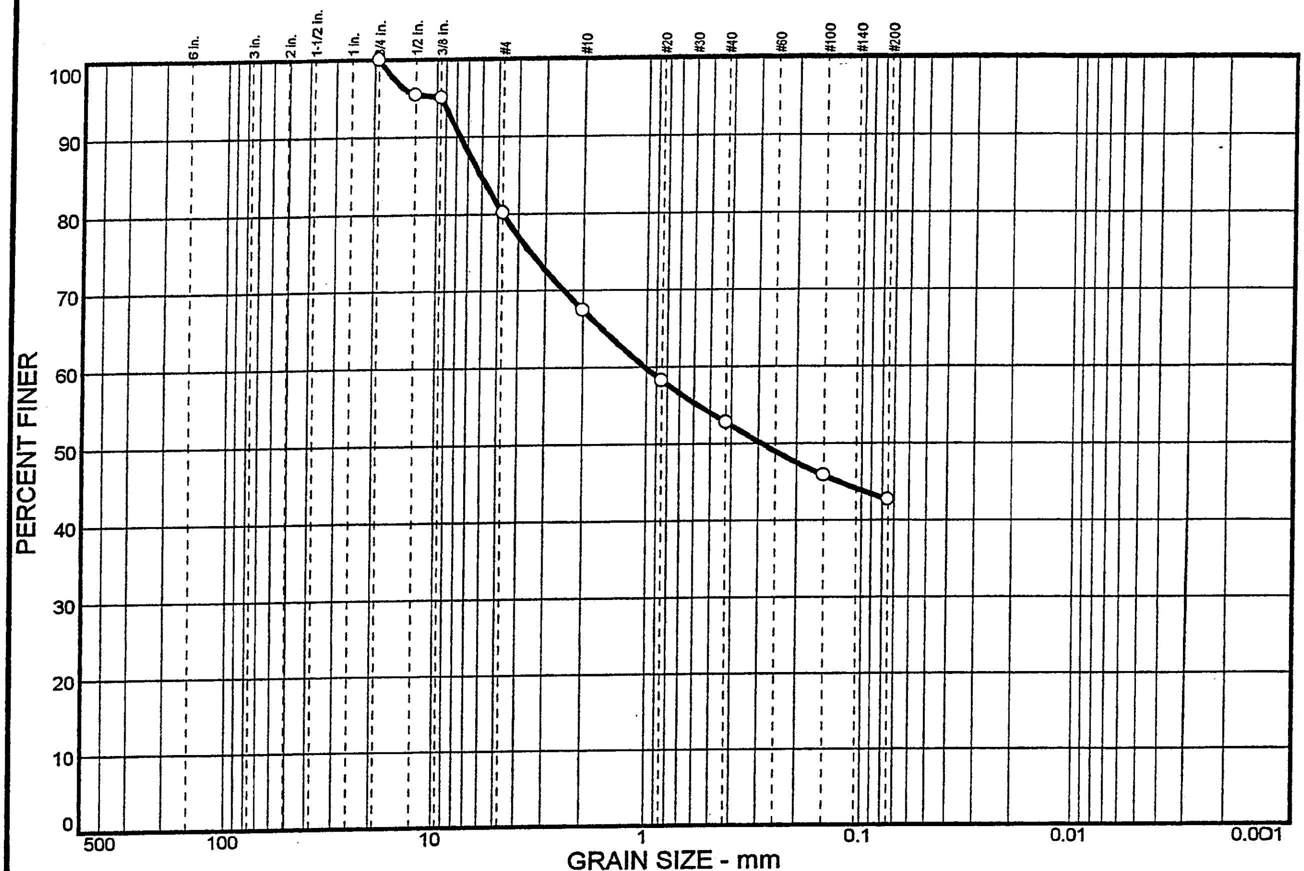
Remarks

Sample No.: 28-A **Source of Sample:** CB-MP98-2 **Date:** 5/28/98
Location: X=629360.401 Y=218704.992 **Elev./Depth:** 40.5' @ 42.0'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	19.8	37.5	42.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75 in.	100.0		
.5 in.	95.5		
.375 in.	95.1		
#4	80.2		
#10	67.5		
#20	58.3		
#40	52.8		
#100	45.9		
#200	42.7		

* (no specification provided)

Soil Description

Organic clayey SAND, little gravel, black.

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 6.05 D_{60}= 1.02 D_{50}= 0.288
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SC AASHTO= A-8

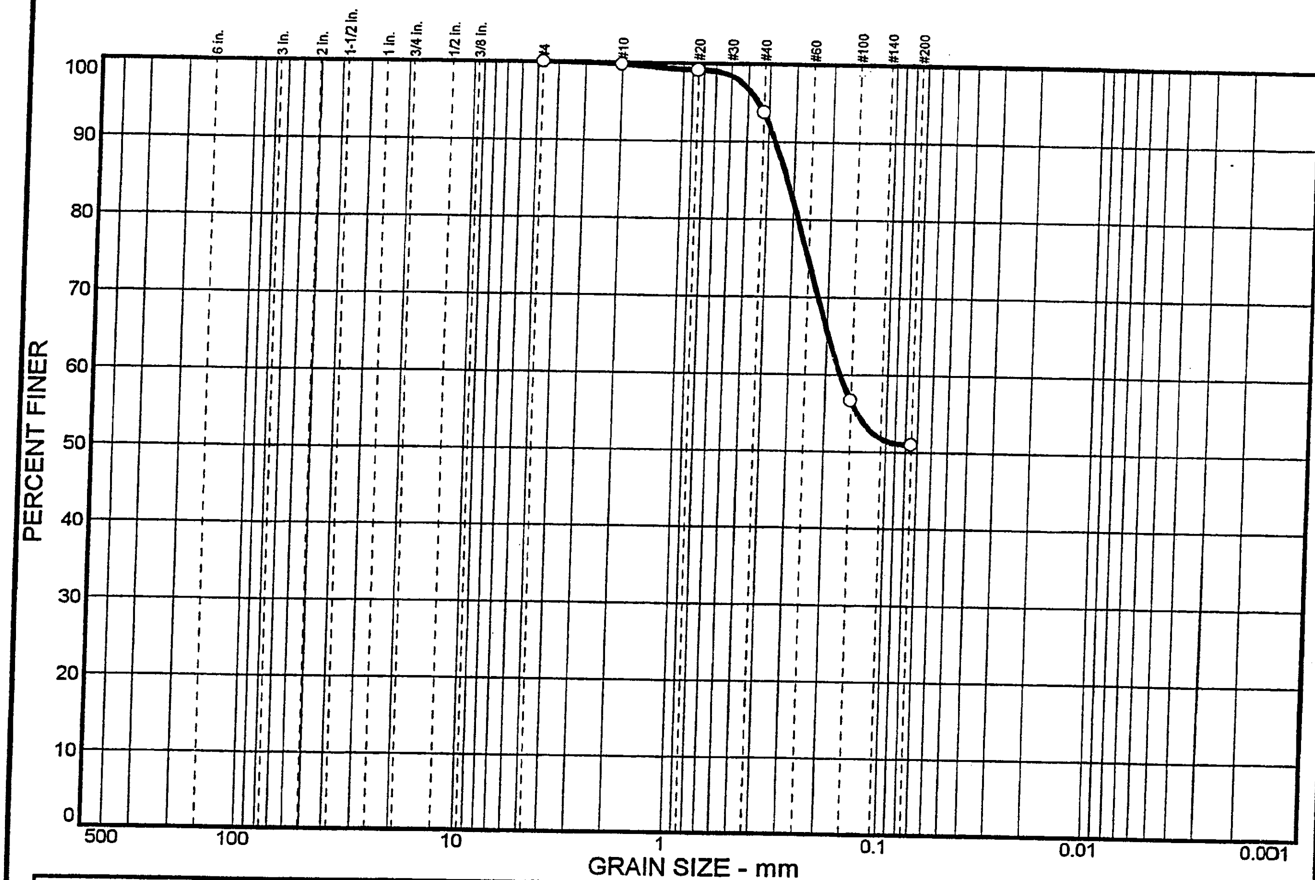
Remarks

Sample No.: 8-A **Source of Sample:** CB-MP98-3 **Date:** 6/2/98
Location: X=630015.422 Y=218689.853 **Elev./Depth:** 10.5' @ 12'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	49.0	51.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.8		
#20	99.2		
#40	93.8		
#100	56.7		
#200	51.0		

* (no specification provided)

Soil Description

Sandy CLAY, brown.

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.321 D_{60}= 0.169 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

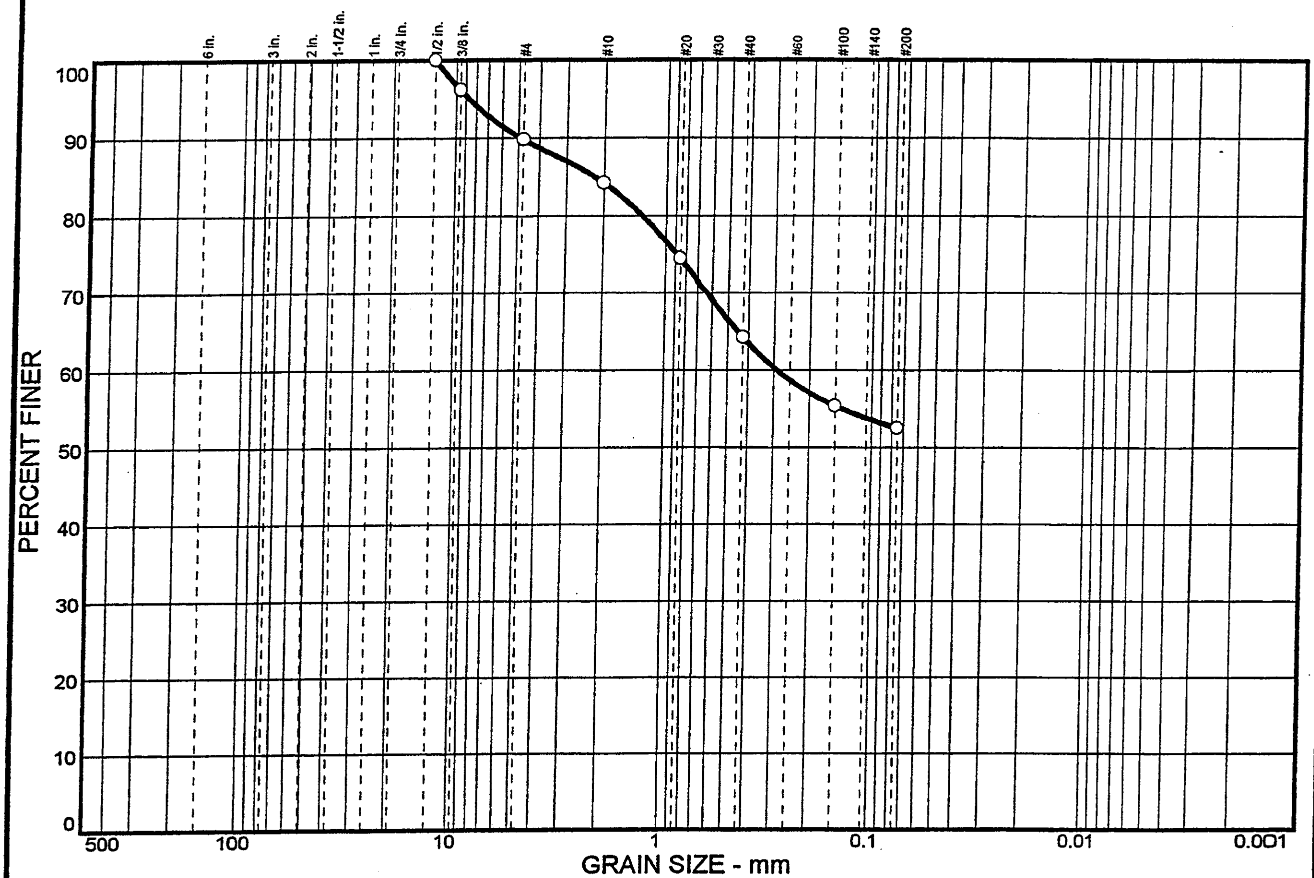
Remarks

Sample No.: 21-A **Source of Sample:** CB-MP98-3 **Date:** 6/2/98
Location: X=630015.422 Y=218689.853 **Elev./Depth:** 30'@31.5'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	10.2	37.3	52.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5 in.	100.0		
.375 in.	96.2		
#4	89.8		
#10	84.2		
#20	74.5		
#40	64.3		
#100	55.4		
#200	52.5		

* (no specification provided)

Soil Description

Sandy CLAY,little gravel,

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 2.22 D_{60}= 0.288 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

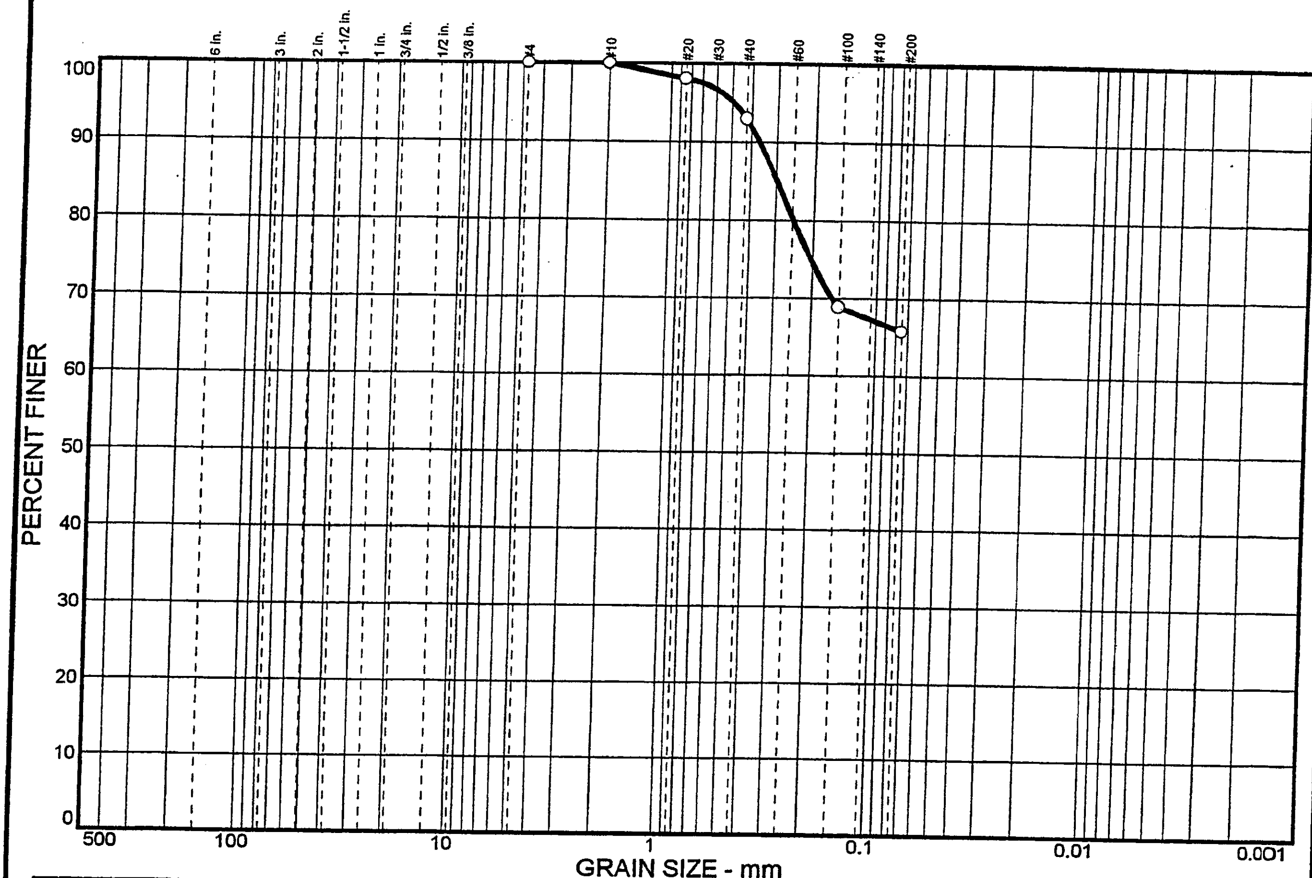
Remarks

Sample No.: 29-A **Source of Sample:** CB-MP98-4 **Date:** 6/8/98
Location: X=630435.250 Y=219065.189 **Elev./Depth:** 42.0' @ 43.5'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	34.2	65.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	98.1		
#40	93.0		
#100	68.9		
#200	65.8		

* (no specification provided)

Soil Description

CLAY, some sand, gray.

Atterberg Limits

PL= 19.8 LL= 45.5 PI= 25.7

Coefficients

D_{85}= 0.297 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

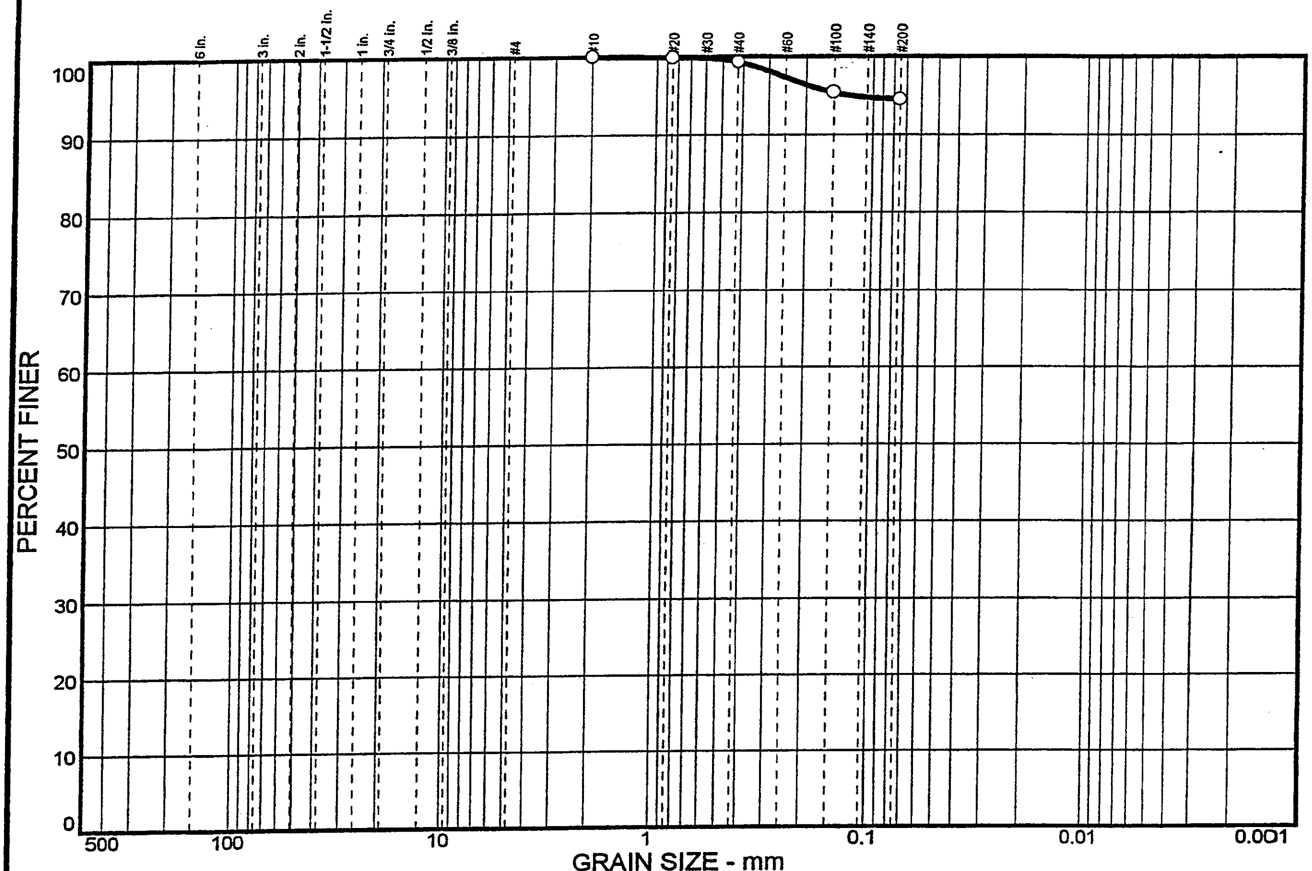
Remarks

Sample No.: 10-A **Source of Sample:** CB-MP98-5 **Date:** 6/8/98
Location: X=630353.121 Y=218800.702 **Elev./Depth:** 13.5' @ 15.0'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	5.5	94.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.9		
#40	99.3		
#100	95.4		
#200	94.5		

* (no specification provided)

Soil Description

CLAY, trace sand, dark yellowish brown.

Atterberg Limits

PL= 32.2 LL= 78.5 PI= 46.3

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

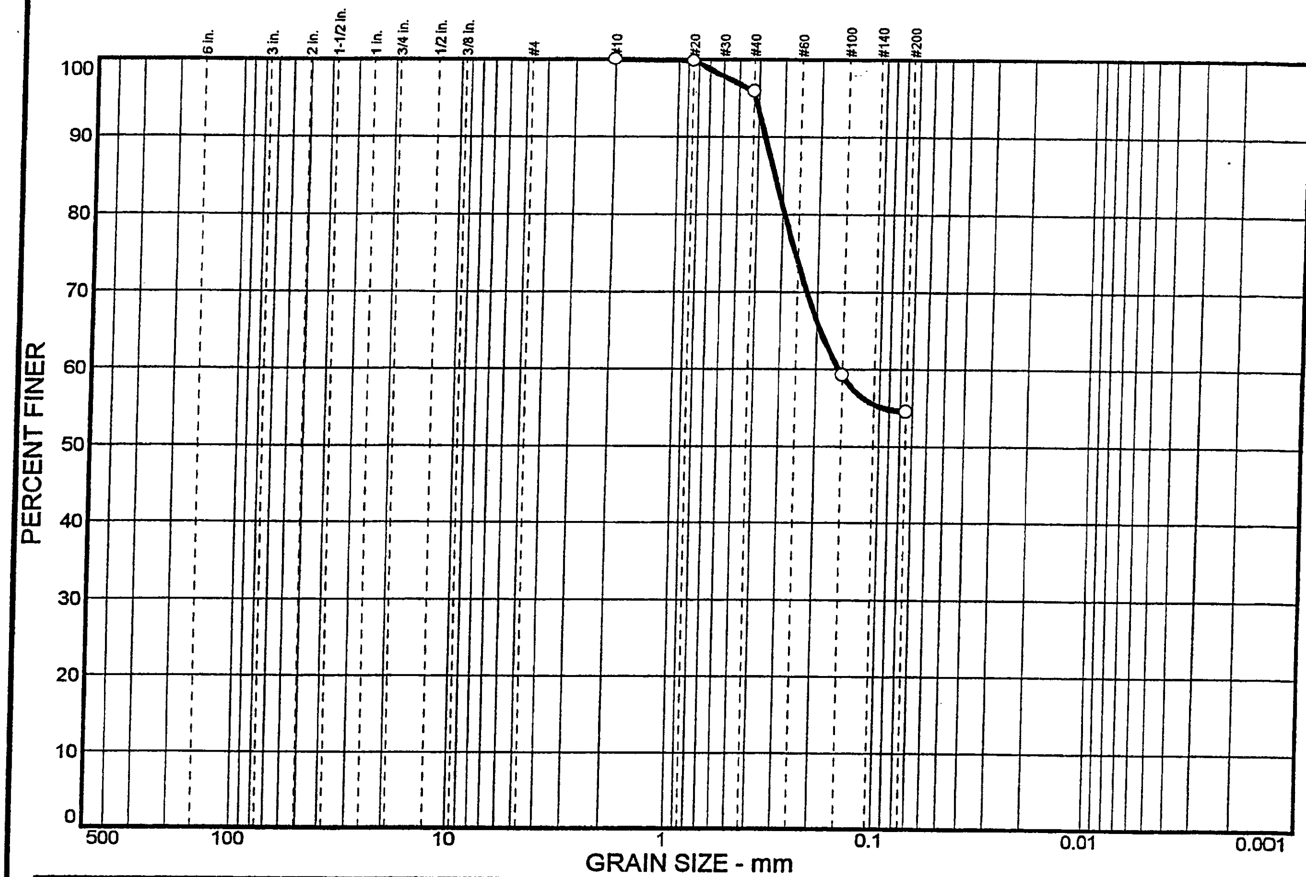
Remarks

Sample No.: 20-A **Source of Sample:** CB-MP98-5 **Date:** 6/8/98
Location: X=630353.121 Y=218800.702 **Elev./Depth:** 28.5' @ 30.0'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	45.5	54.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.8		
#40	95.9		
#100	59.3		
#200	54.5		

* (no specification provided)

Soil Description

Sandy CLAY, gray.

Atterberg Limits

PL= 16.5 LL= 35.0 PI= 18.5

Coefficients

D_{85}= 0.330 D_{60}= 0.156 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

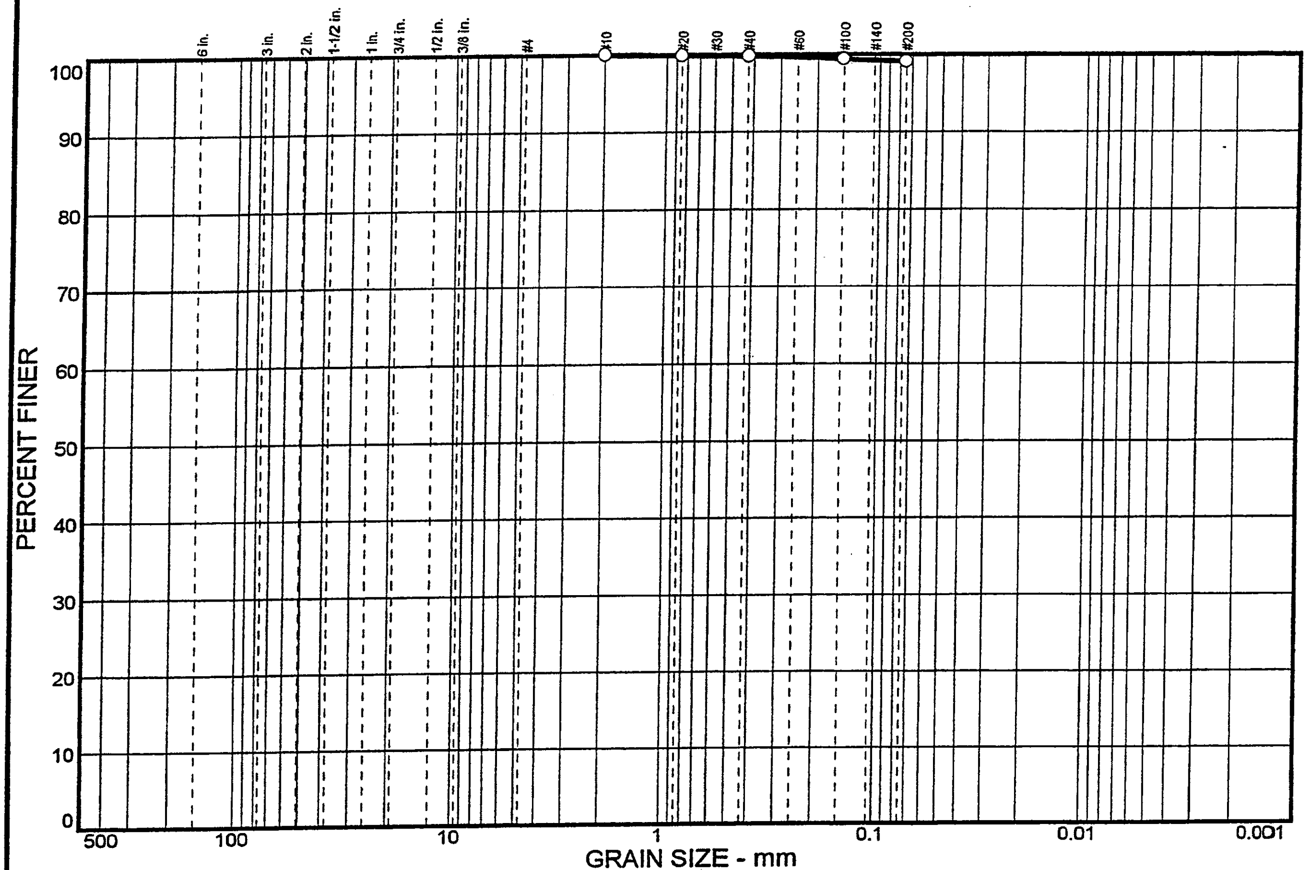
Remarks

Sample No.: 9-A **Source of Sample:** CB-MP98-6 **Date:** 6/15/98
Location: X=630765.324 Y=218550.100 **Elev./Depth:** 12.0' @ 13.5'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 R. Davila-GCI

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	0.9	99.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.9		
#40	99.8		
#100	99.4		
#200	99.1		

* (no specification provided)

Soil Description

CLAY, trace sand, brown to gray.

Atterberg Limits

PL= 28.2 LL= 89.0 PI= 60.8

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

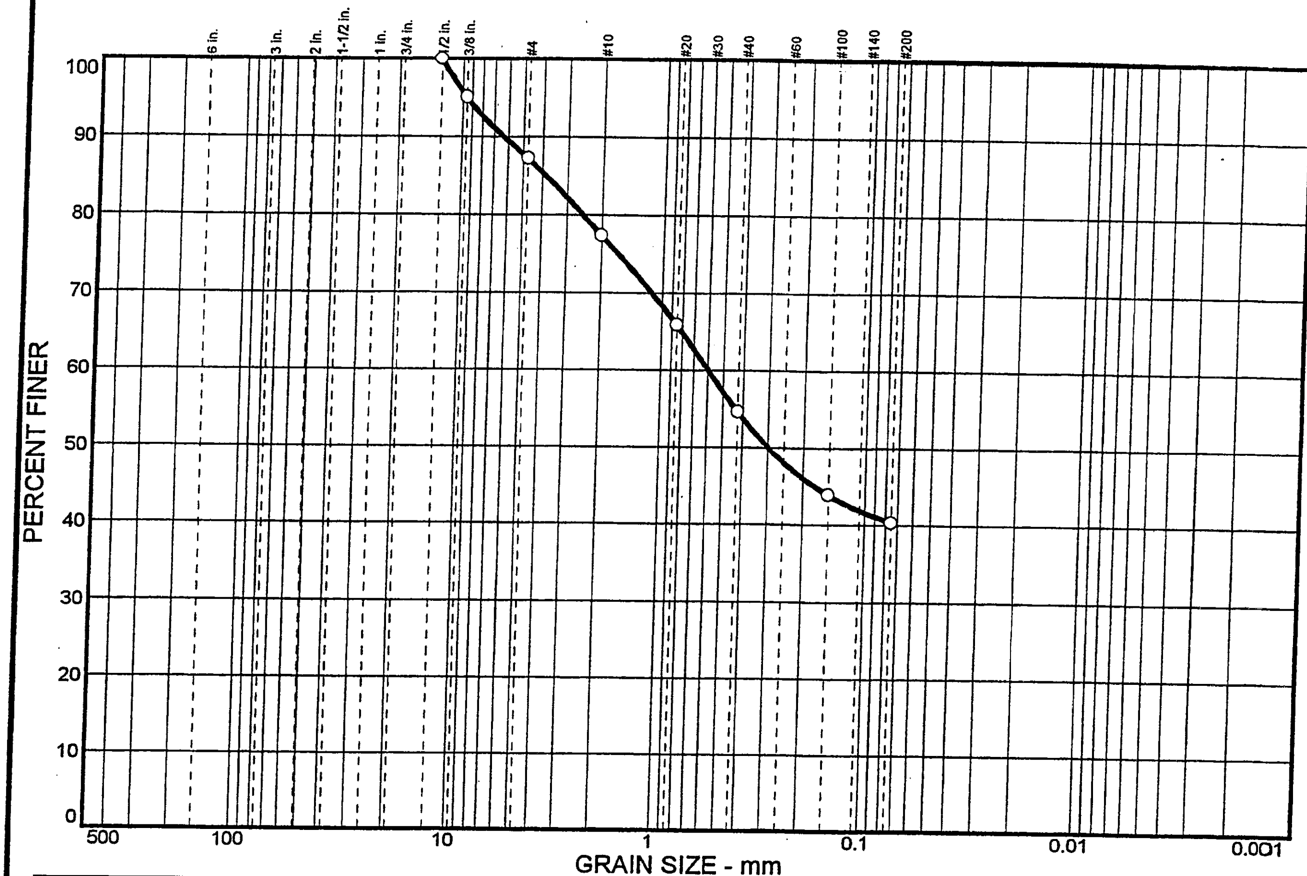
Remarks

Sample No.: 17-A **Source of Sample:** CB-MP98-6 **Date:** 6/15/98
Location: X=630765.324 Y=218550.100 **Elev./Depth:** 24.0' @ 25.5'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	12.8	46.9	40.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5 in.	100.0		
.375 in.	95.1		
#4	87.2		
#10	77.4		
#20	65.9		
#40	54.7		
#100	43.9		
#200	40.3		

* (no specification provided)

Soil Description

Clayey SAND, little silt, little gravel, brown to dark brown.

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 3.85 D_{60}= 0.593 D_{50}= 0.297
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SC AASHTO=

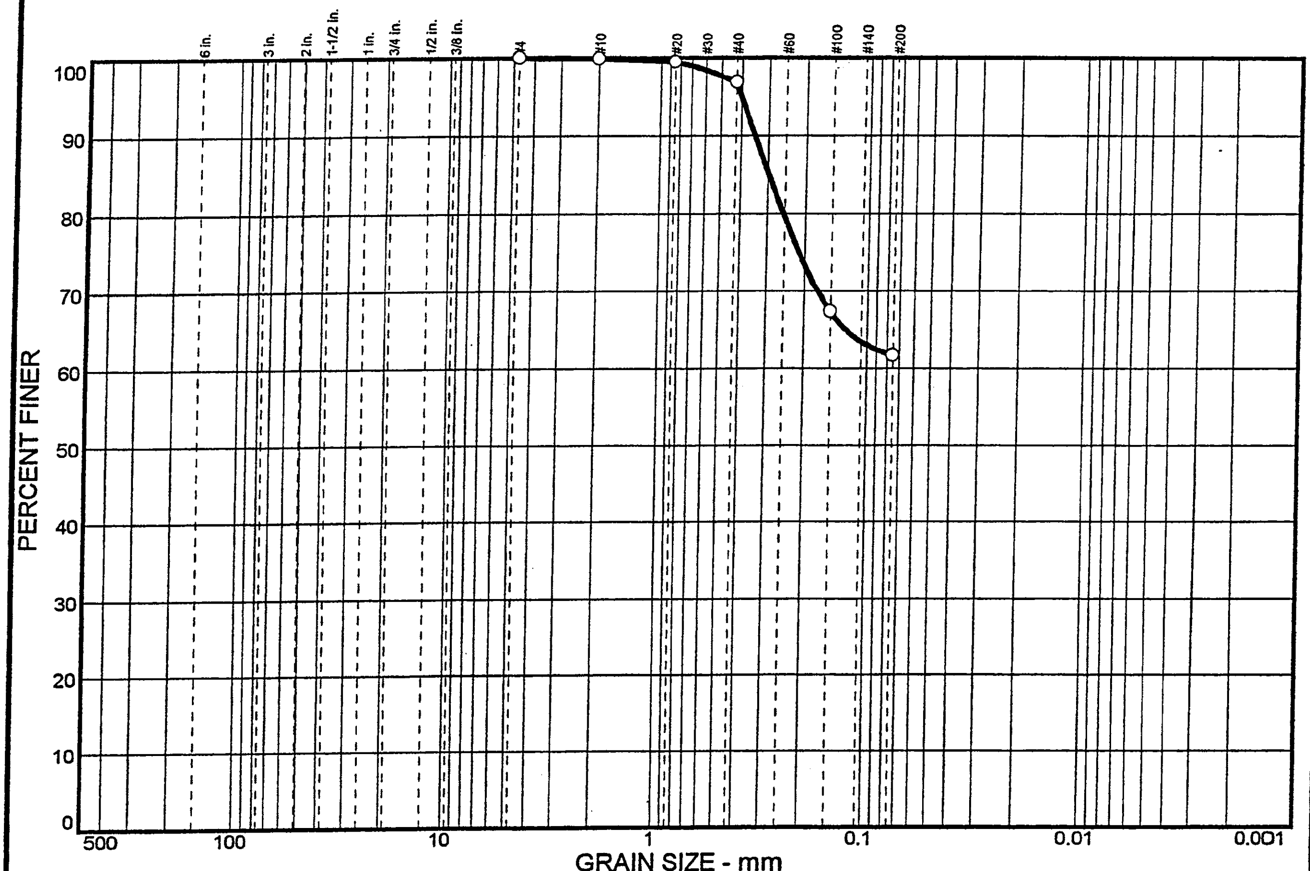
Remarks

Sample No.: 33-A **Source of Sample:** CB-MP98-6 **Date:** 6/15/98
Location: X=630765.324 Y=218550.100 **Elev./Depth:** 48.0' @ 49.5'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 R. Davila-GCI

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	38.3	61.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#20	99.5		
#40	96.9		
#100	67.4		
#200	61.7		

* (no specification provided)

Soil Description

Sandy CLAY, light gray, yellowish brown.

Atterberg Limits

PL= 20.07 LL= 46.2 PI= 26.13

Coefficients

D_{85}= 0.296 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

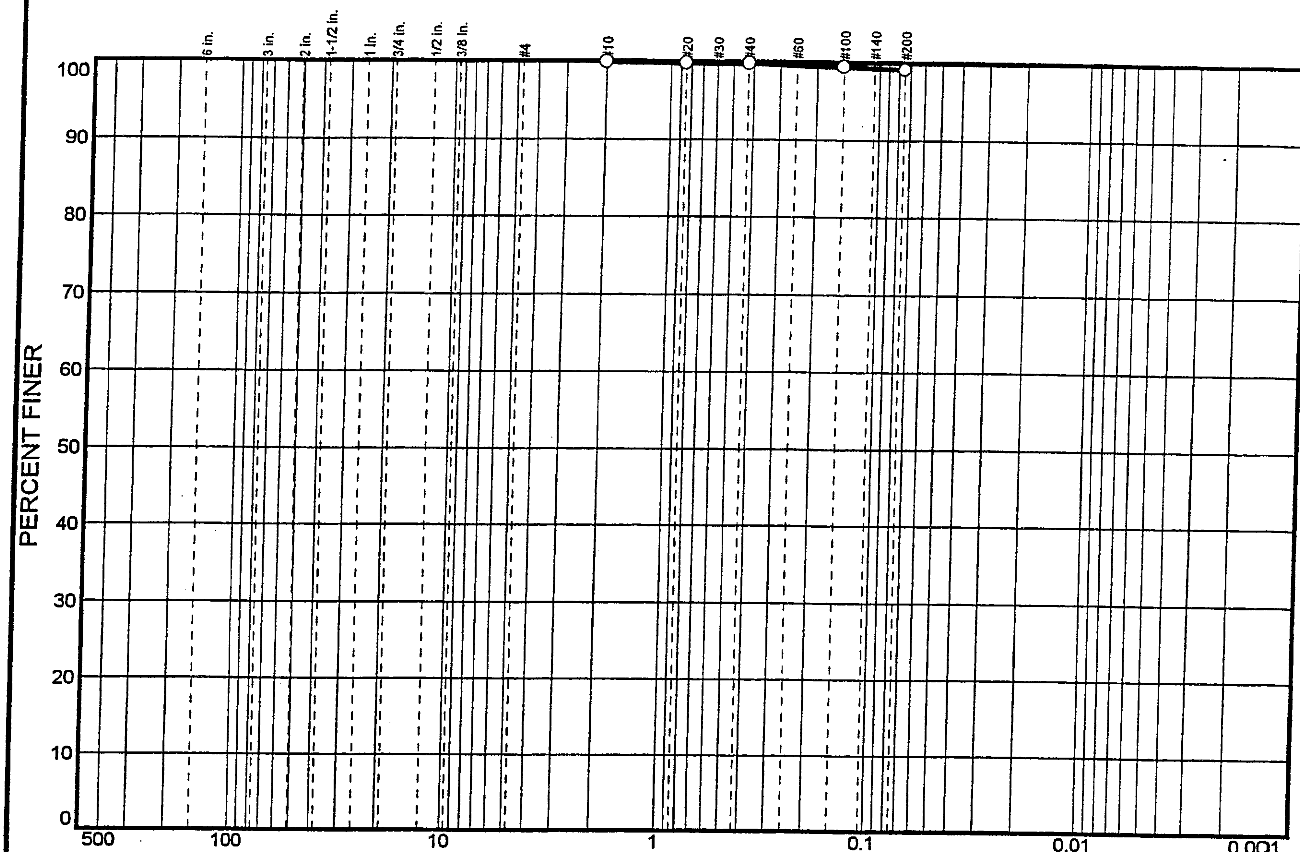
Remarks

Sample No.: 12-A **Source of Sample:** CB-MP98-7 **Date:** 6/8/98
Location: X=630864.655 Y=217859.898 **Elev./Depth:** 16.5' @ 18.0'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	0.8	99.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.9		
#40	99.9		
#100	99.5		
#200	99.2		

* (no specification provided)

Soil Description

Clay, trace sand, dark yellowish brown, gray.

Atterberg Limits

PL= 30.43 LL= 91.0 PI= 60.57

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

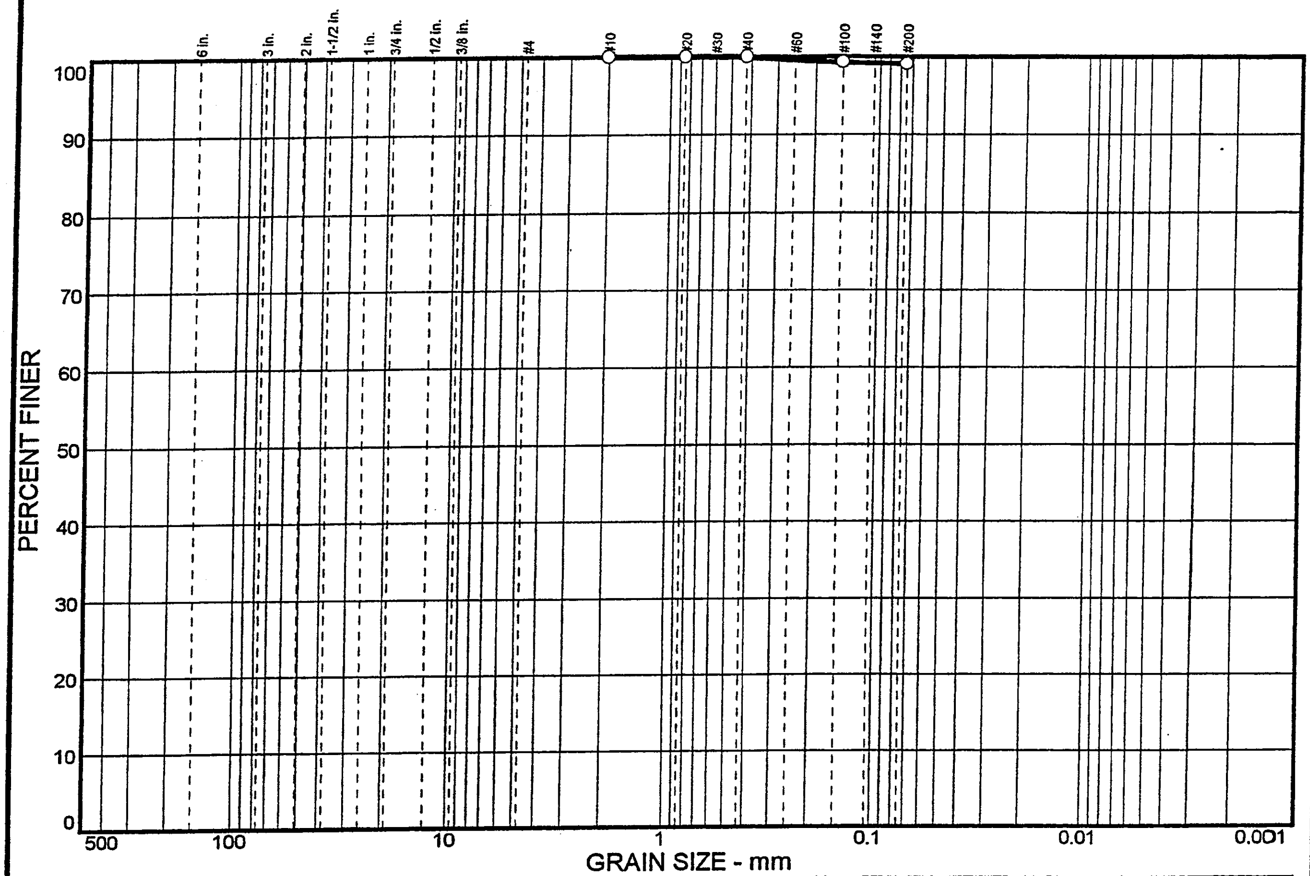
Remarks

Sample No.: 19-A **Source of Sample:** CB-MP98-7 **Date:** 6/89/98
Location: X=630864.655 Y=217859.898 **Elev./Depth:** 27.0' @ 28.5'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	0.9	99.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	100.0		
#40	100.0		
#100	99.3		
#200	99.1		

* (no specification provided)

Soil Description

CLAY, trace sand, dark yellowish brown, gray.

Atterberg Limits

PL= 32.03 LL= 97.0 PI= 64.97

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

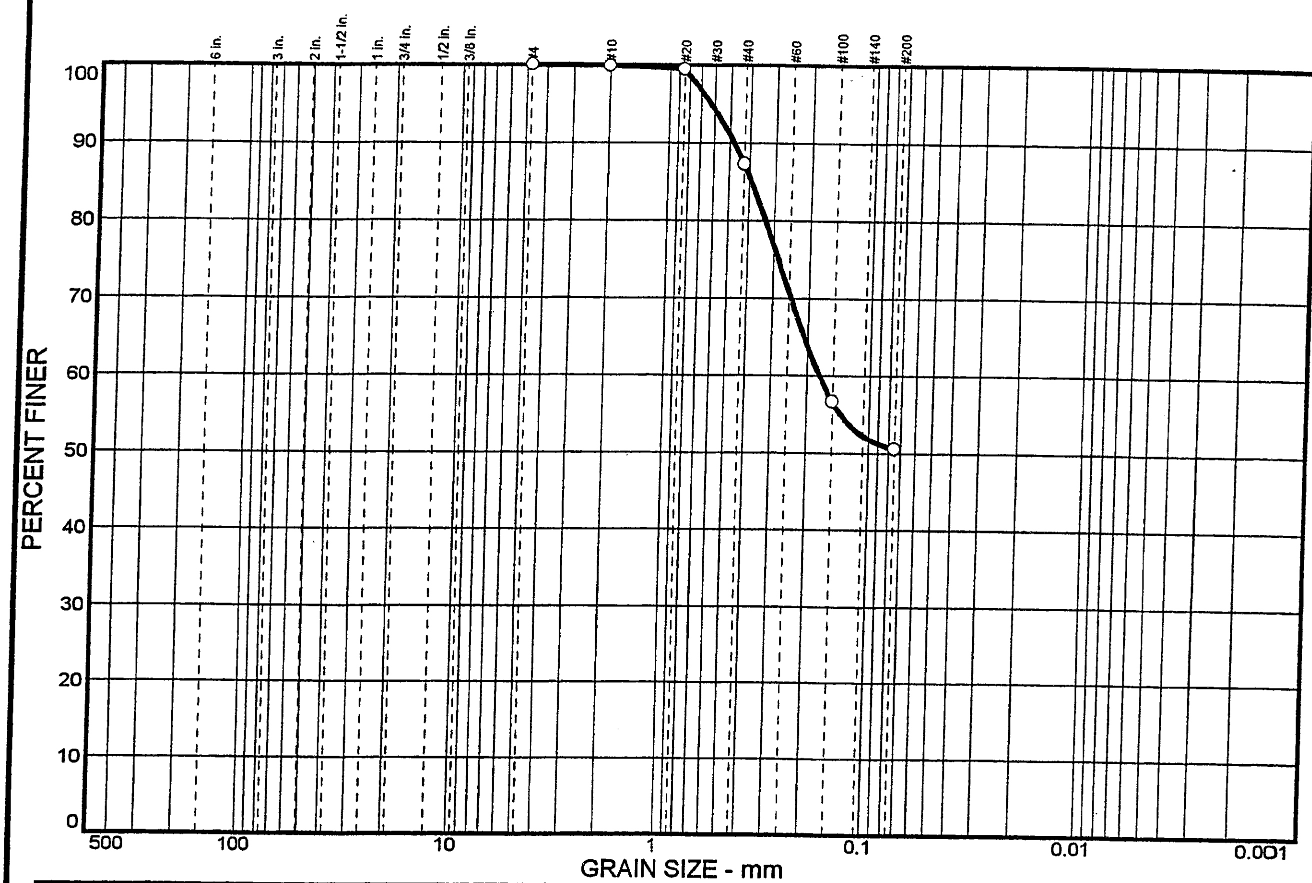
Remarks

Sample No.: 25-A **Source of Sample:** CB-MP98-7 **Date:** 6/9/98
Location: X=630864.655 Y=217859.898 **Elev./Depth:** 36.0' @ 37.5'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	49.4	50.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#20	99.5		
#40	87.3		
#100	56.7		
#200	50.6		

* (no specification provided)

Soil Description

Sandy CLAY, olive and brown.

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.390 D_{60}= 0.174 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

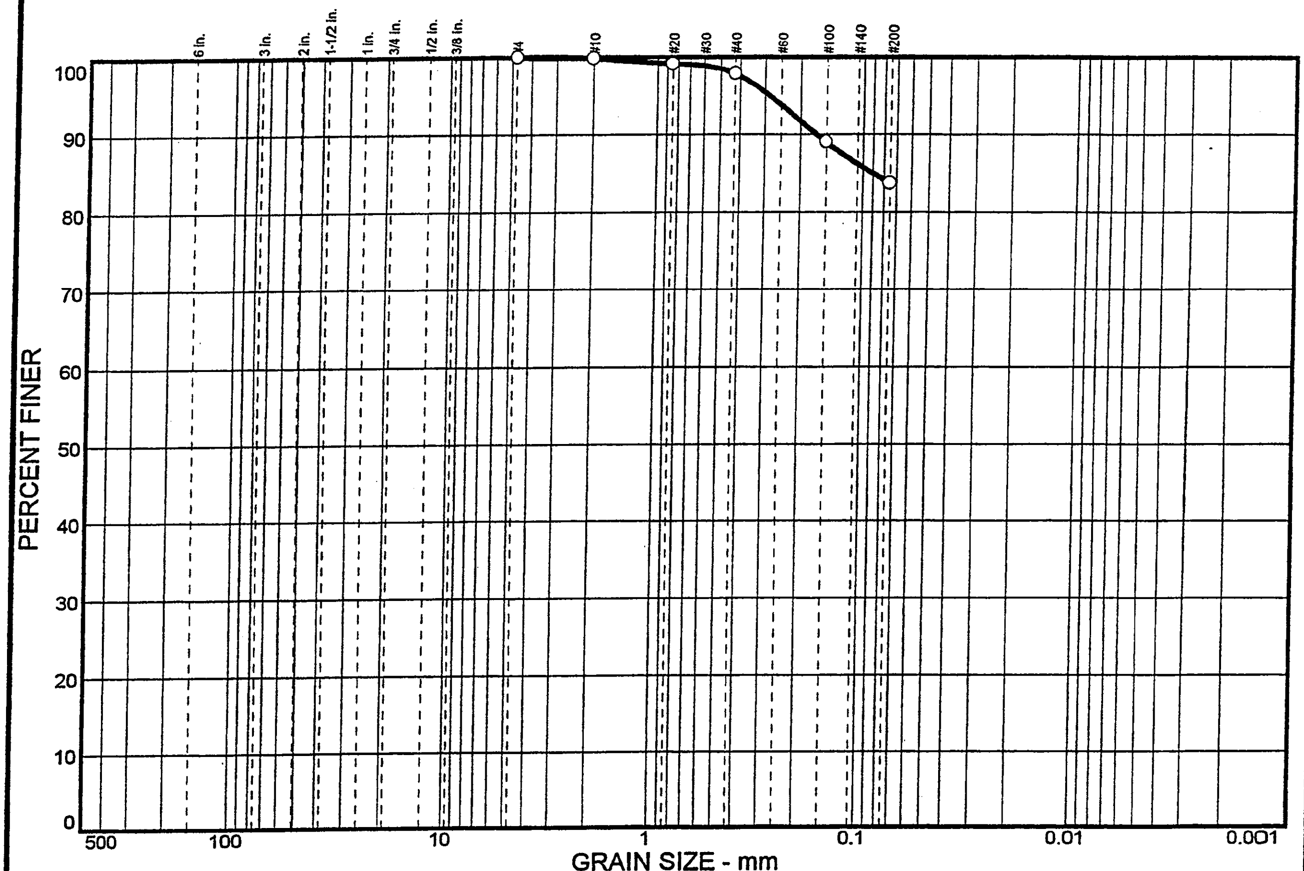
Remarks

Sample No.: 7-A **Source of Sample:** CB-MP98-8 **Date:** 6/9/97
Location: X=631245.523 Y=217771.241 **Elev./Depth:** 9.0' @ 10.5'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	16.3	83.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#20	99.2		
#40	97.9		
#100	89.0		
#200	83.7		

* (no specification provided)

Soil Description

CLAY, little sand, light gray to grayish brown.

Atterberg Limits

PL= 32.3 LL= 72.0 PI= 39.7

Coefficients

D_{85}= 0.0902 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

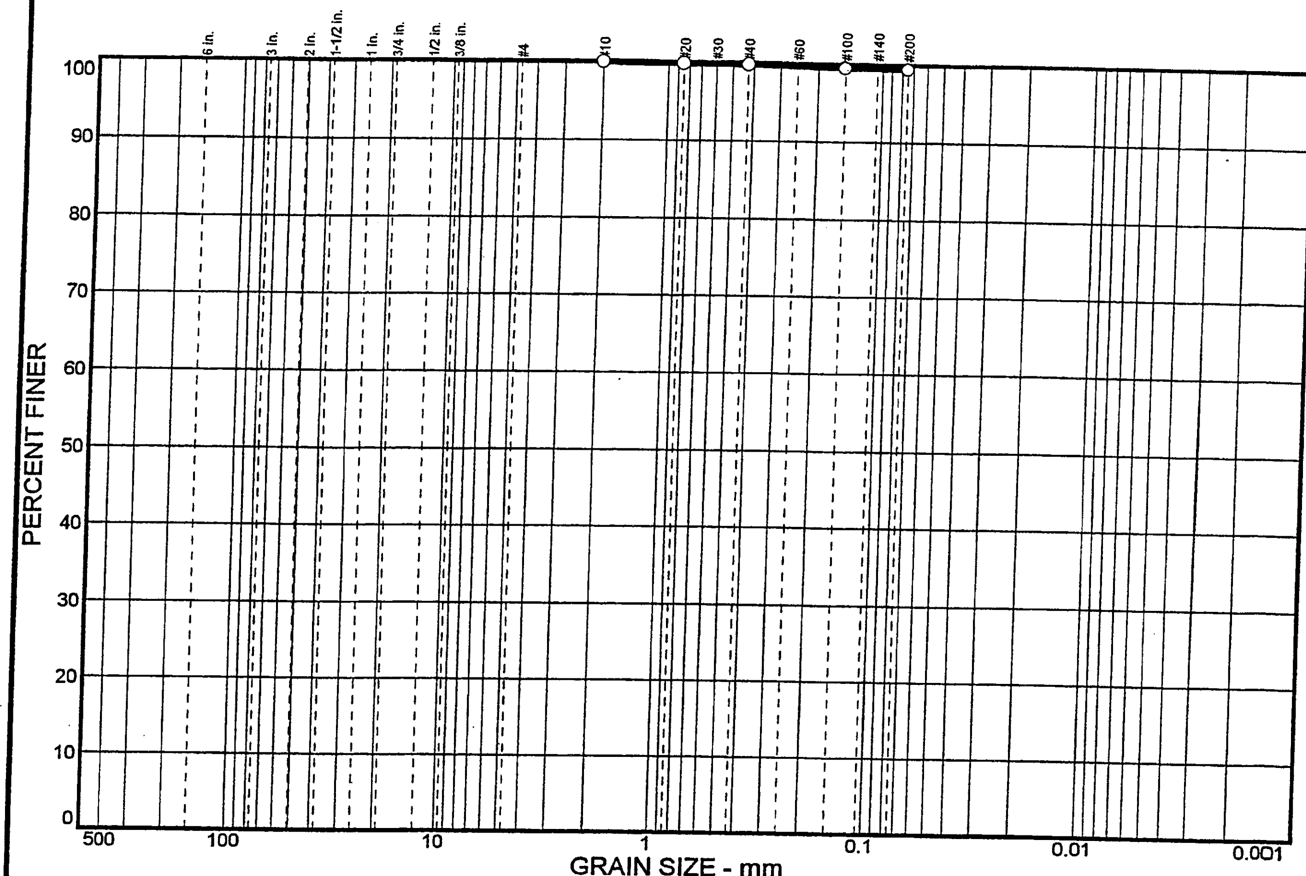
Remarks

Sample No.: 11-A **Source of Sample:** CB-MP98-8 **Date:** 6/9/98
Location: X=631245.523 Y=217771.241 **Elev./Depth:** 15.0' @ 16.5'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	0.6	99.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.9		
#40	99.8		
#100	99.5		
#200	99.4		

* (no specification provided)

Soil Description

CLAY, trace sand, yellowish brown, light gray.

Atterberg Limits

PL= 34.5 LL= 101.5 PI= 67.0

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

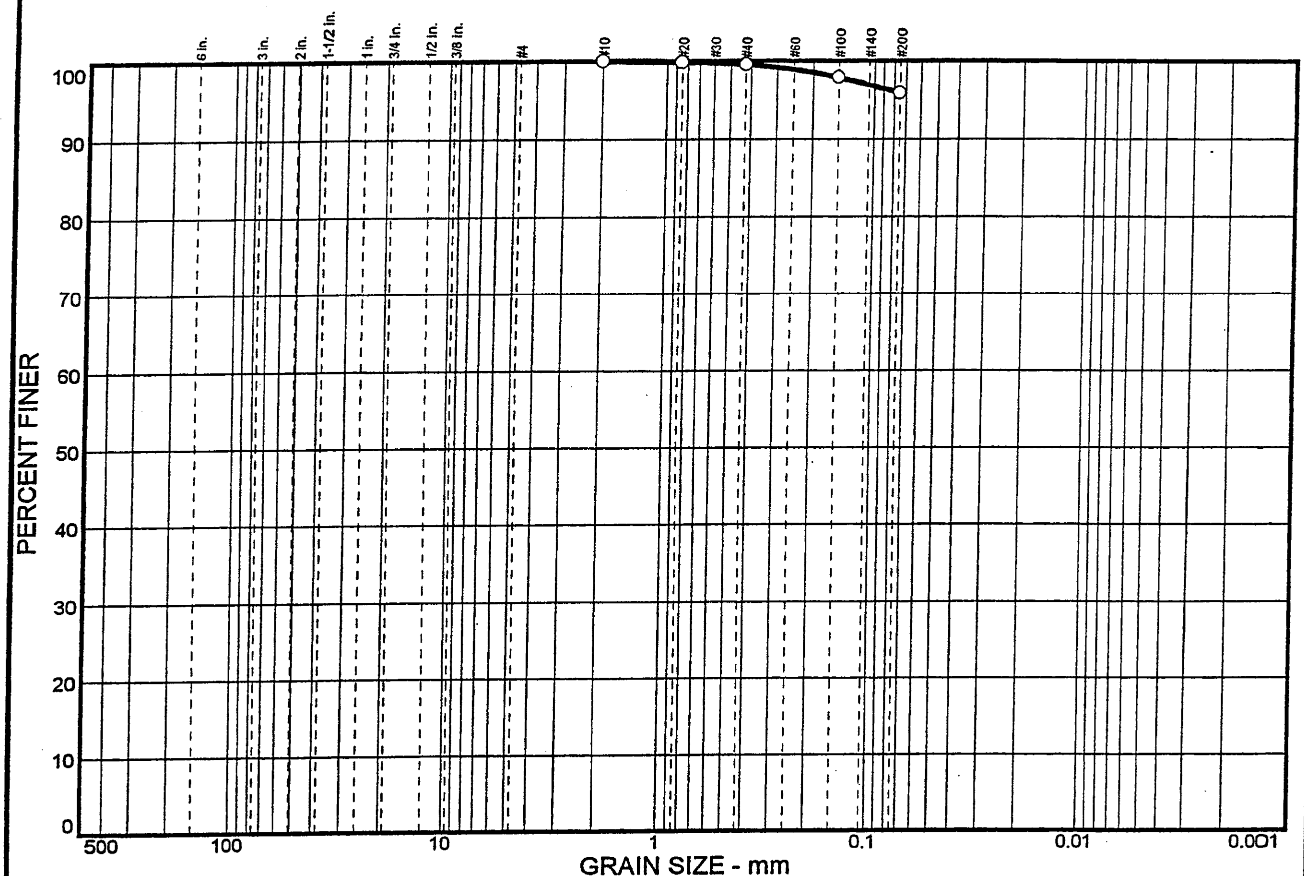
Remarks

Sample No.: 19-A **Source of Sample:** CB-MP98-8 **Date:** 6/18/98
Location: X=631245.523 Y=217771.241 **Elev./Depth:** 27.0' @ 28.5'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	4.1	95.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.9		
#40	99.6		
#100	97.9		
#200	95.9		

* (no specification provided)

Soil Description

silt,trace sand, dark yellowish brown, red.

Atterberg Limits

PL= 43.5 LL= 82.9 PI= 39.4

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO=

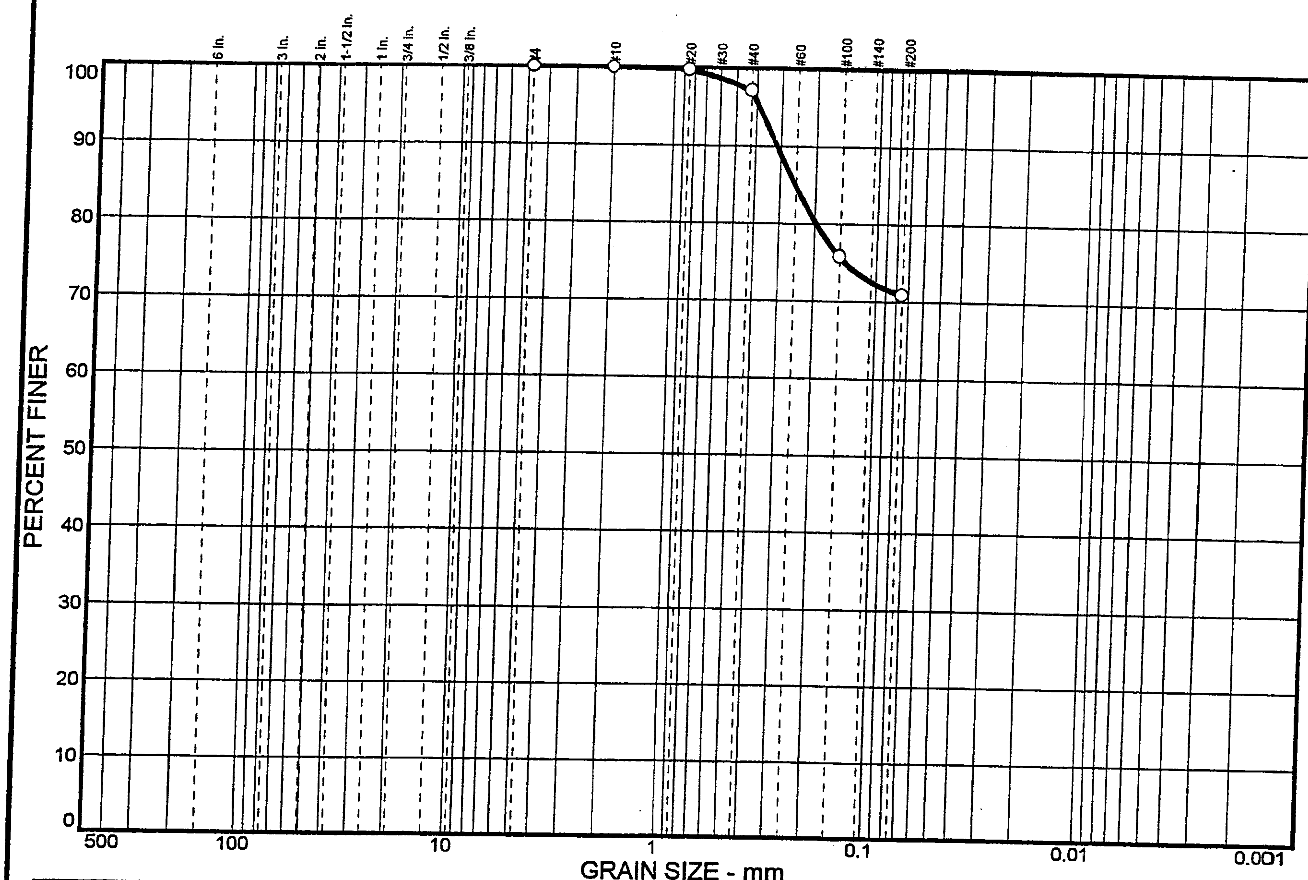
Remarks

Sample No.: 22-A **Source of Sample:** CB-MP98-8 **Date:** 6/9/98
Location: X=631245.523 Y=217771.241 **Elev./Depth:** 31.5' @ 33.0'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	29.1	70.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	99.8		
#40	97.2		
#100	75.8		
#200	70.9		

* (no specification provided)

Soil Description

CLAY, some sand, gray.

Atterberg Limits

PL= 19.4 LL= 46.8 PI= 27.4

Coefficients

D_{85}= 0.251 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

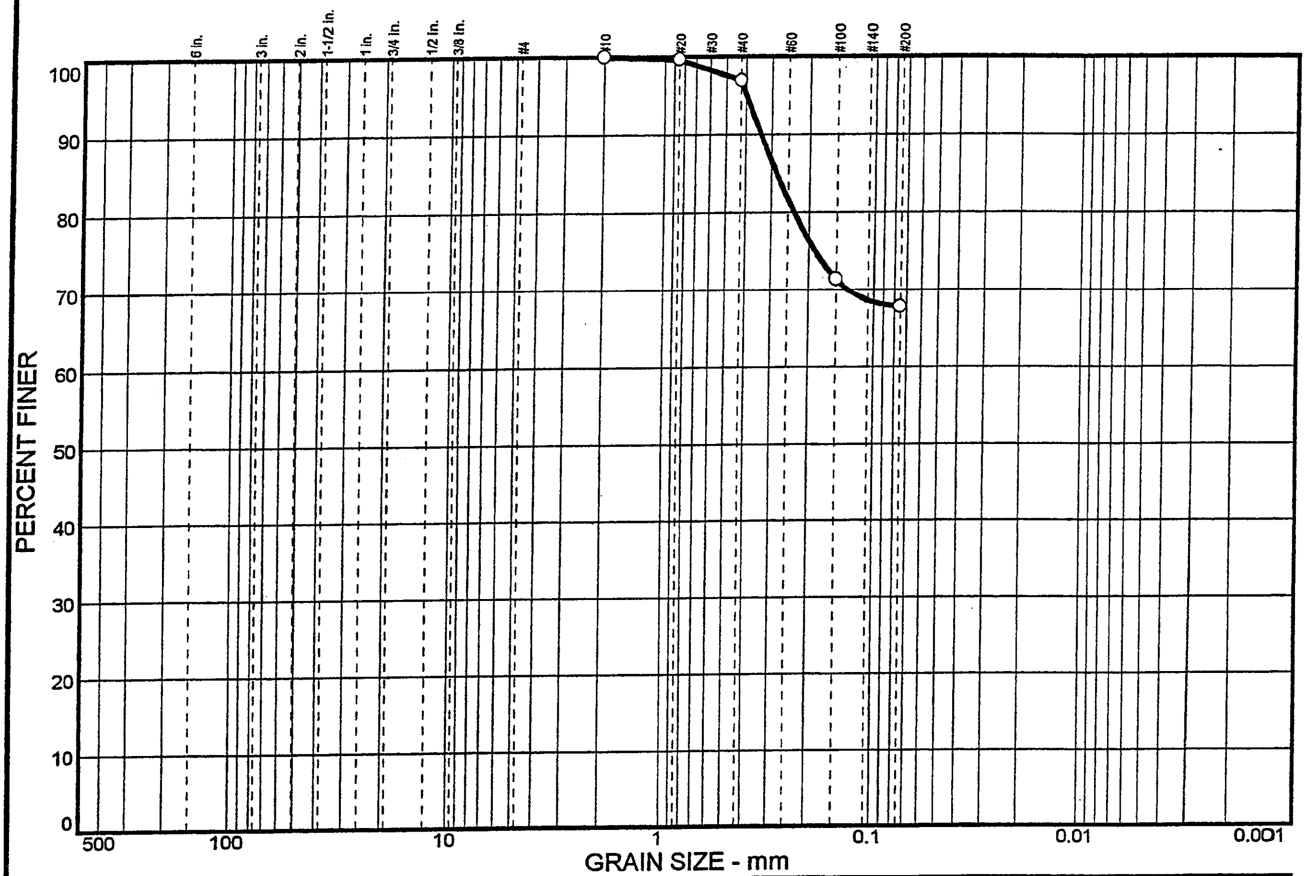
Remarks

Sample No.: 12-A **Source of Sample:** CB-MP98-10 **Date:** 6/15/98
Location: X=631543.392 Y=218107.496 **Elev./Depth:** 16.5' @ 18.0'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 R. Davila-GCI

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	32.2	67.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.7		
#40	97.0		
#100	71.4		
#200	67.8		

* (no specification provided)

Soil Description

CLAY, some sand, brown.

Atterberg Limits

PL= 20.1 LL= 49.0 PI= 28.9

Coefficients

D_{85}= 0.283 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

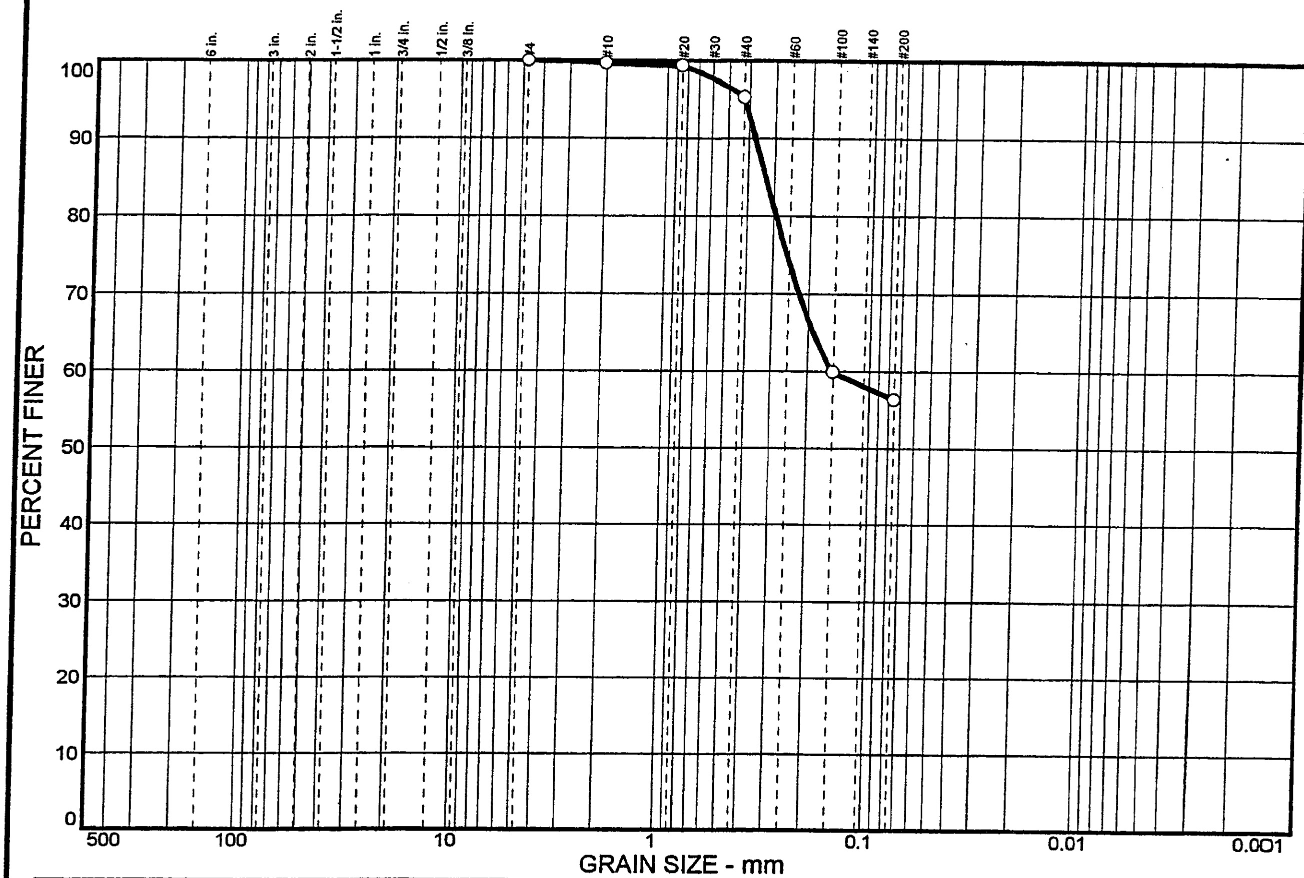
Remarks

Sample No.: 8-A **Source of Sample:** CB-MP98-11 **Date:** 6/18/98
Location: X=631864.241 Y=218574.242 **Elev./Depth:** 10.5' @ 12.0'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	43.7	56.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.7		
#20	99.4		
#40	95.3		
#100	59.9		
#200	56.3		

* (no specification provided)

Soil Description

Sandy CLAY, brown to reddish brown to gray.

Atterberg Limits

PL= 19.2 LL= 48.0 PI= 28.8

Coefficients

D_{85}= 0.330 D_{60}= 0.151 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

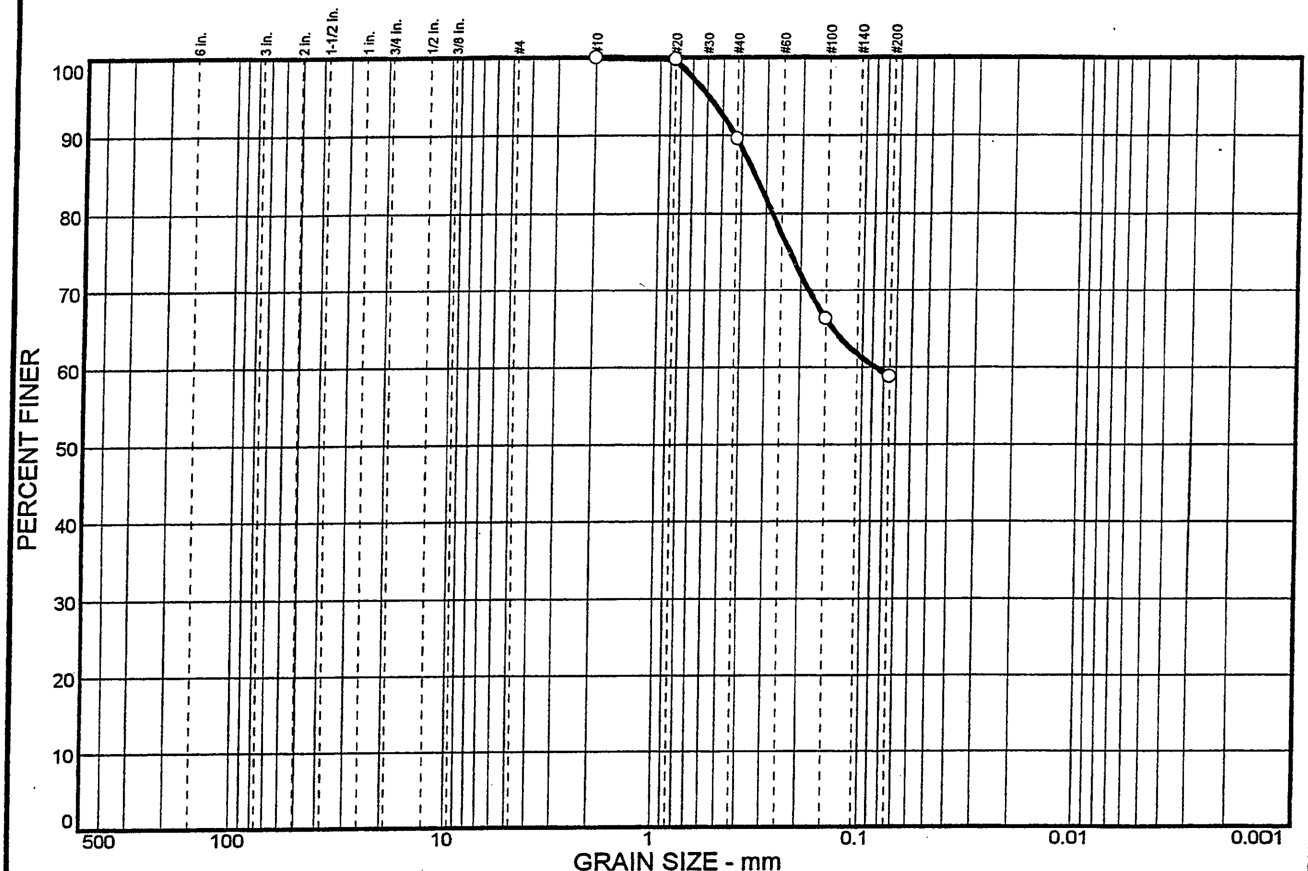
Remarks

Sample No.: 15-A **Source of Sample:** CB-MP98-11 **Date:** 6/18/98
Location: X=631864.241 Y=218574.242 **Elev./Depth:** 21.0' @ 22.5'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	41.2	58.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.8		
#40	89.6		
#100	66.4		
#200	58.8		

* (no specification provided)

Soil Description

Sandy CLAY, brown to reddish brown.

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.343 D_{60}= 0.0869 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

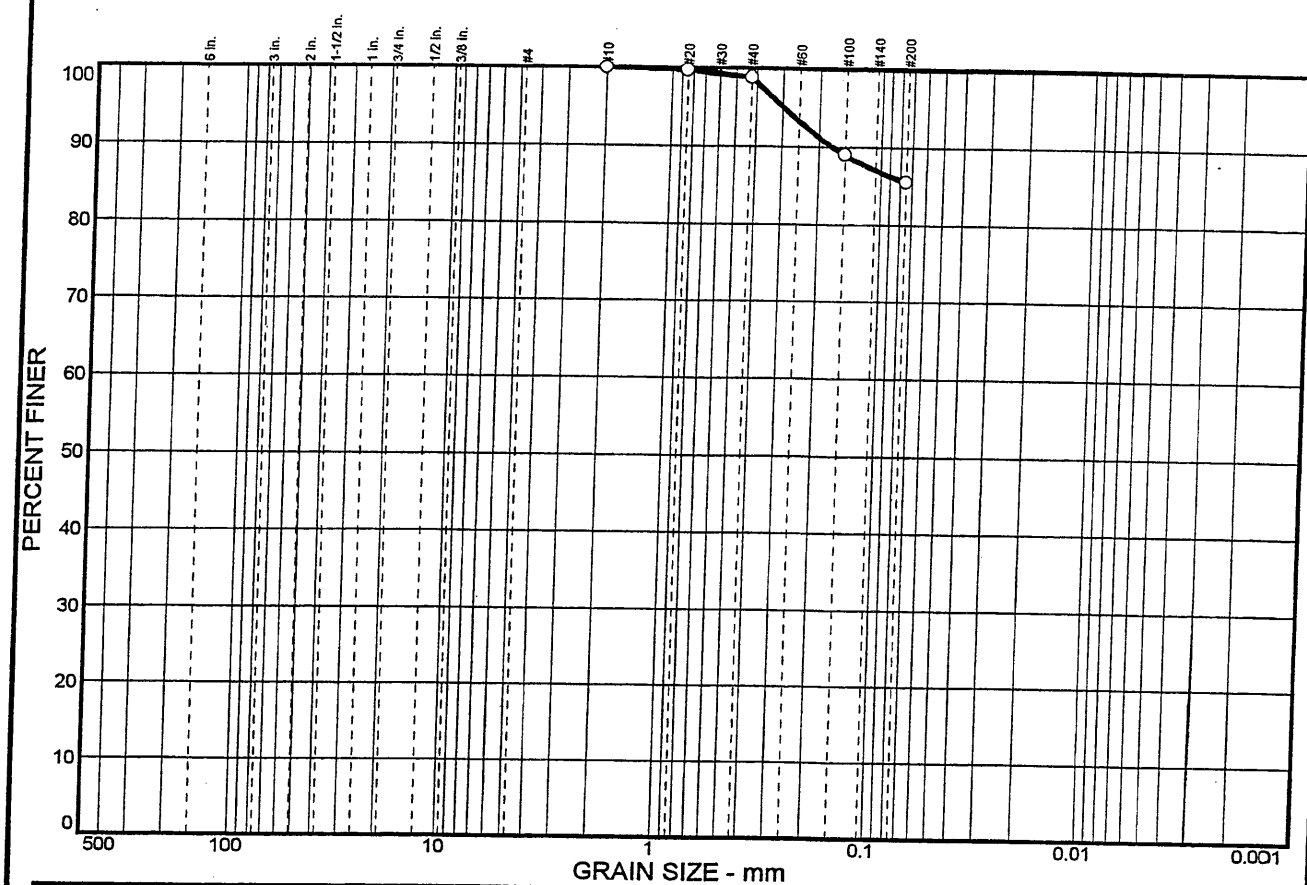
Remarks

Sample No.: 24-A **Source of Sample:** CB-MP98-11 **Date:** 6/29/98
Location: X=631864.241 Y=218574.242 **Elev./Depth:** 34.5' @ 36.0'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	14.5	85.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.8		
#40	98.9		
#100	89.0		
#200	85.5		

* (no specification provided)

Soil Description

CLAY, little sand, gray to green.

Atterberg Limits

PL= 26.4 LL= 56.0 PI= 29.6

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

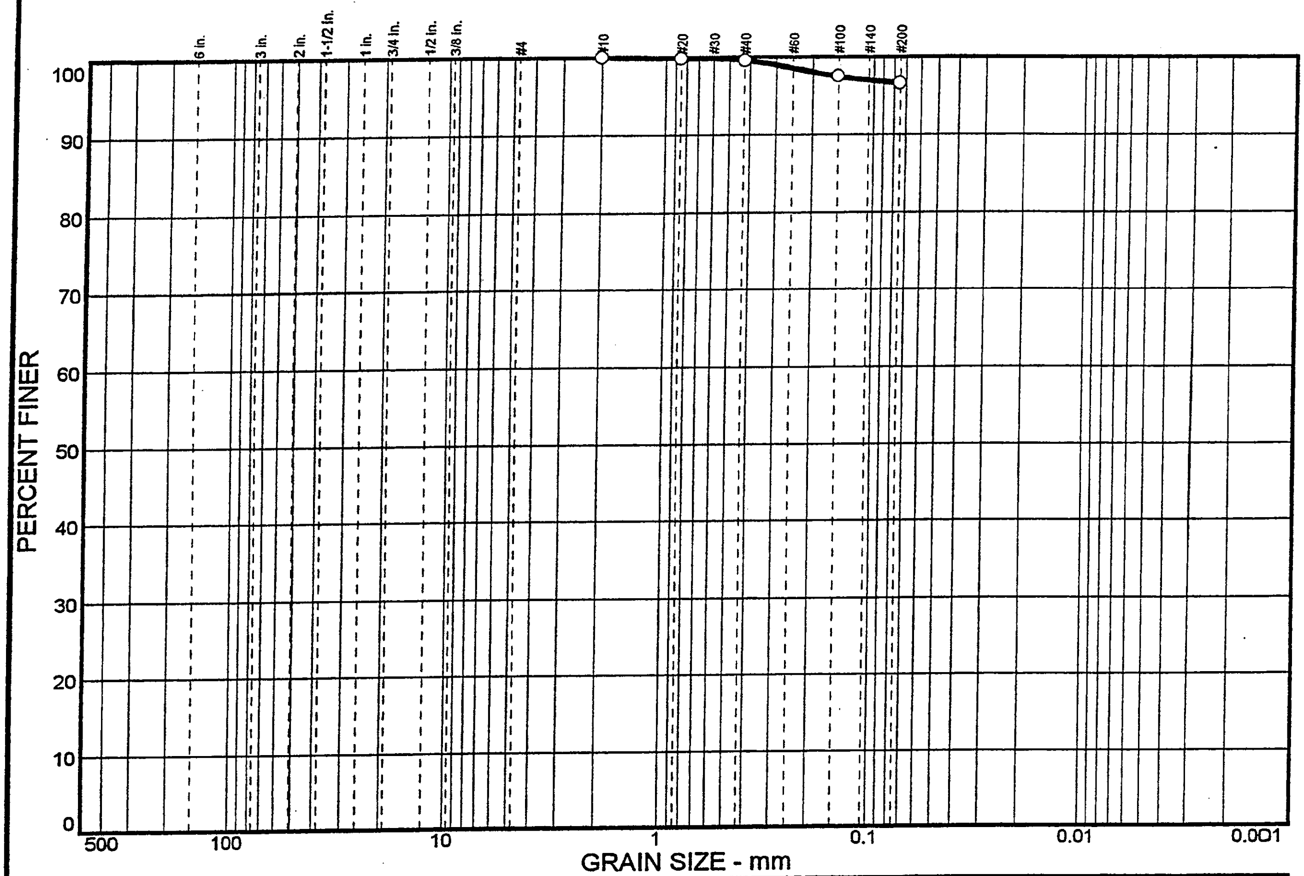
Remarks

Sample No.: 12-A **Source of Sample:** CB-MP98-12 **Date:** 6/15/98
Location: X=632300.418 Y=218009.146 **Elev./Depth:** 16.5' @ 18.0'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	3.4	96.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.9		
#40	99.6		
#100	97.5		
#200	96.6		

* (no specification provided)

Soil Description

SILT, trace sand, brown to reddish brown.

Atterberg Limits

PL= 29.4 LL= 53.6 PI= 24.2

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO=

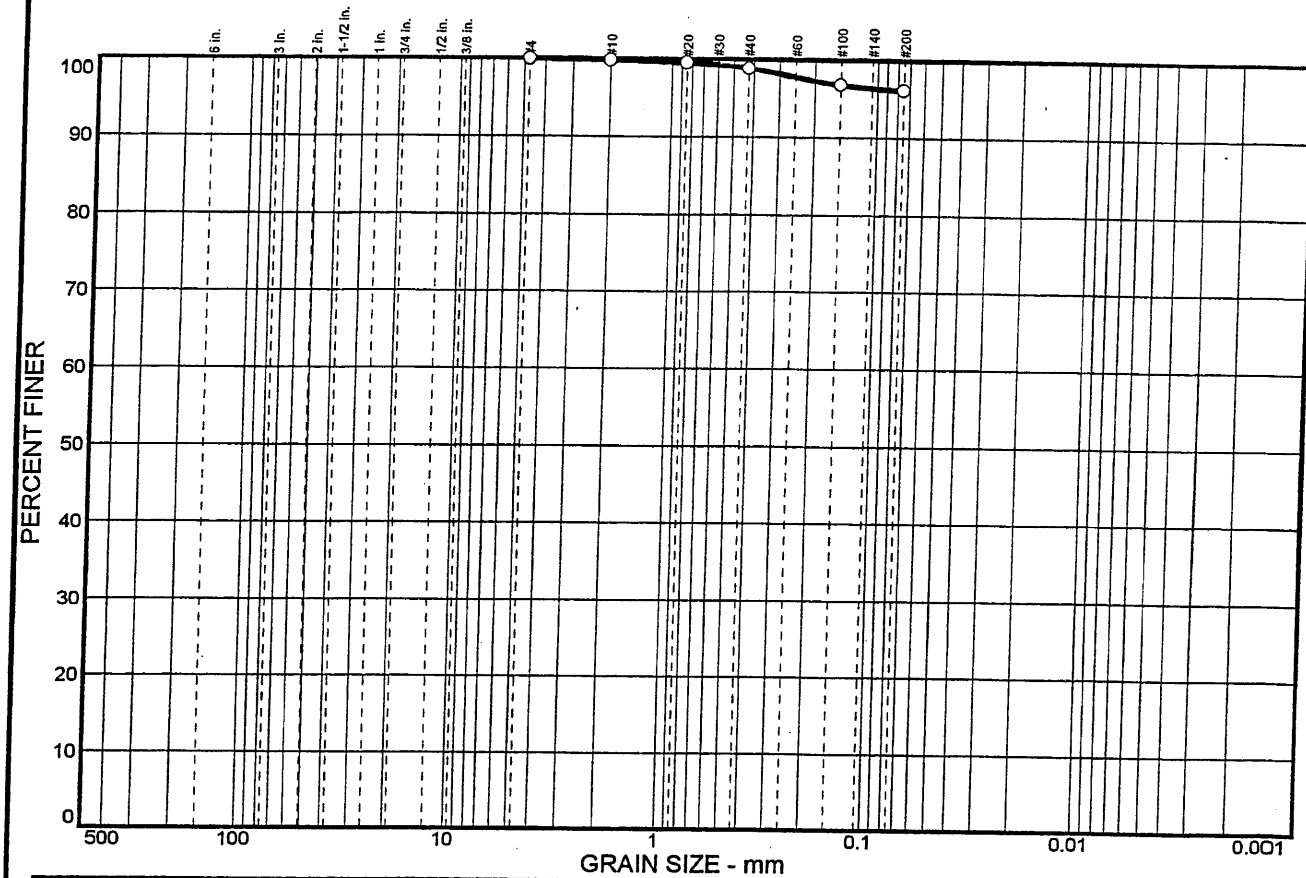
Remarks

Sample No.: 20-A **Source of Sample:** CB-MP98-12 **Date:** 6/15/98
Location: X=632300.418 Y=218009.146 **Elev./Depth:** 28.5' @ 30.0'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	3.9	96.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#20	99.6		
#40	98.9		
#100	96.8		
#200	96.1		

* (no specification provided)

Soil Description

Silty CLAY, brown to reddish brown.

Atterberg Limits

PL= 33.2 LL= 83.5 PI= 50.3

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

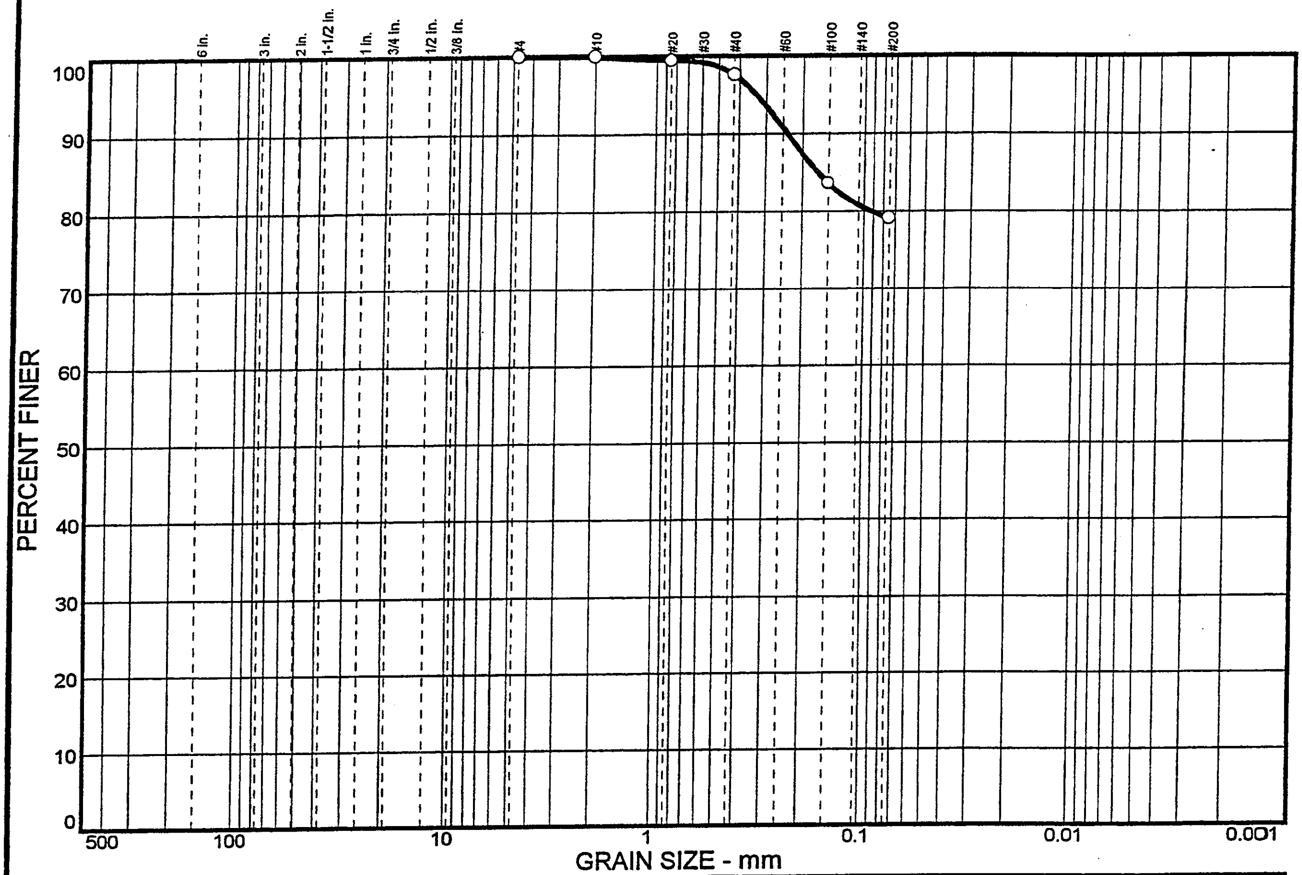
Remarks

Sample No.: 26-A **Source of Sample:** CB-MP98-12 **Date:** 6/15/98
Location: X=632300.418 Y=218009.146 **Elev./Depth:** 37.5' @ 39.0'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	20.9	79.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	99.5		
#40	97.6		
#100	83.6		
#200	79.1		

* (no specification provided)

Soil Description

CLAY, some sand, olive green.

Atterberg Limits

PL= 22.4 LL= 52.0 PI= 29.6

Coefficients

D_{85}= 0.169 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

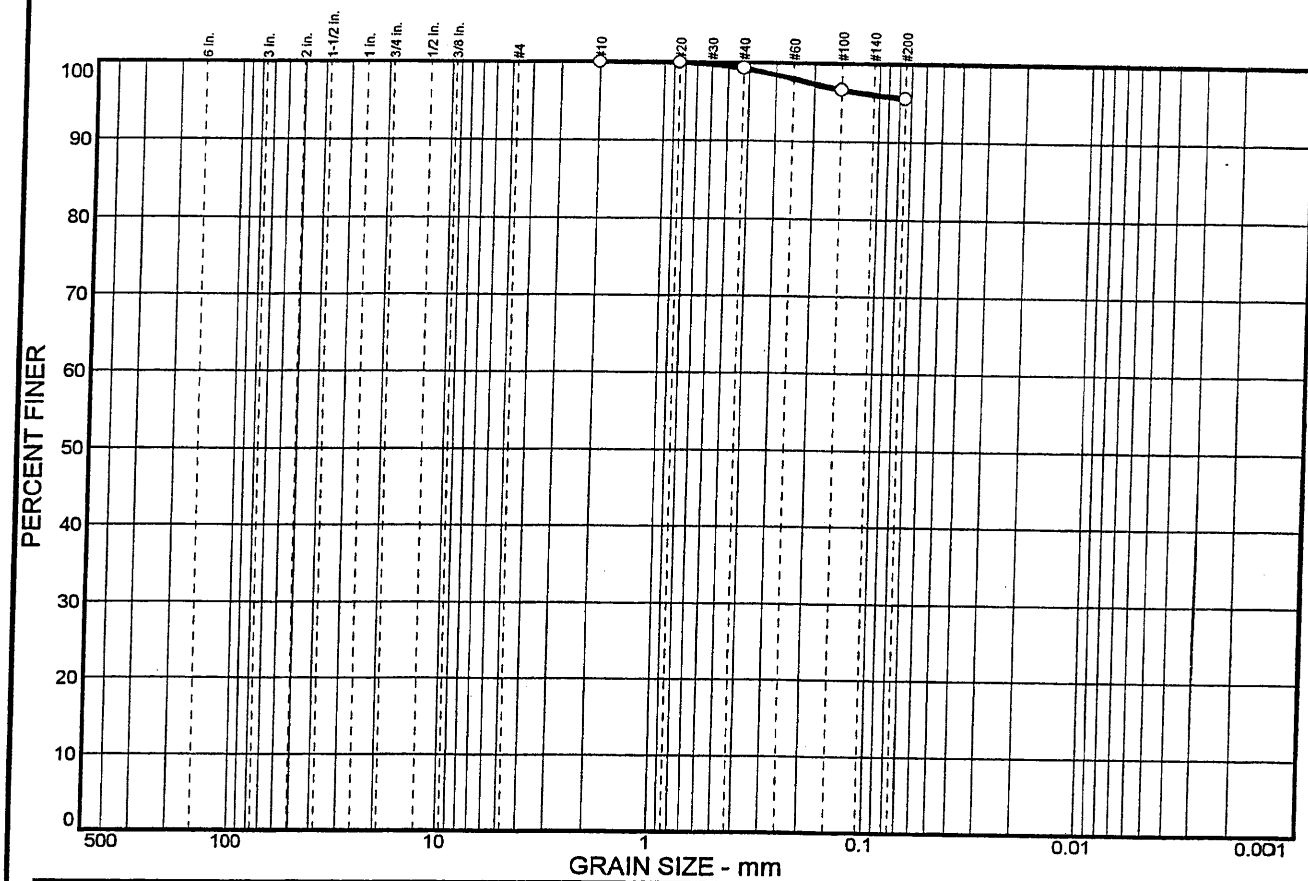
Remarks

Sample No.: 16-A **Source of Sample:** CB-MP98-14 **Date:** 6/25/98
Location: X=633281.747 Y=217755.456 **Elev./Depth:** 22.5' @ 24.0'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	4.4	95.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	100.0		
#40	99.3		
#100	96.7		
#200	95.6		

* (no specification provided)

Soil Description

CLAY, trace sand, gray to brown.

Atterberg Limits

PL= 30.4 LL= 81.5 PI= 51.1

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

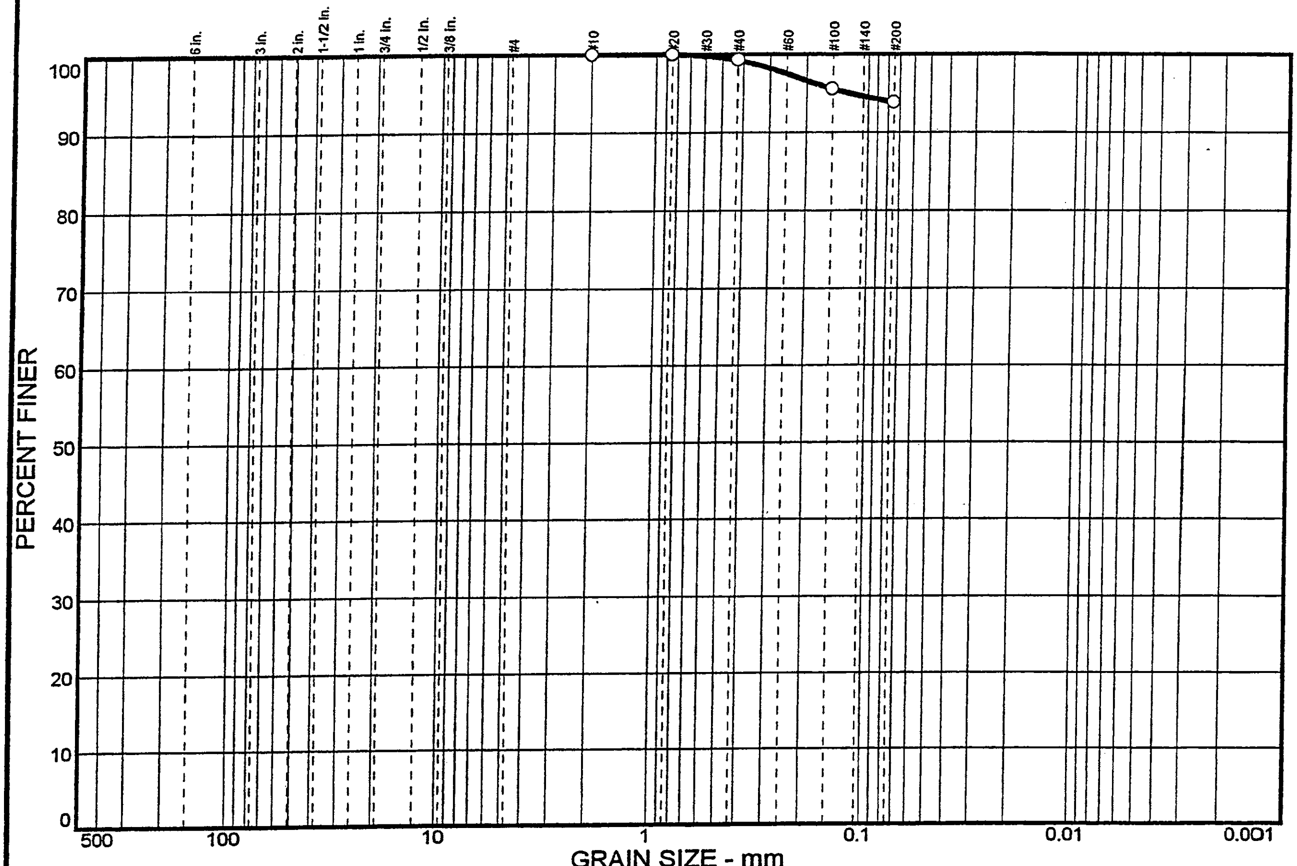
Remarks

Sample No.: 20-A **Source of Sample:** CB-MP98-14 **Date:** 6/25/98
Location: X=633281.747 Y=217755.456 **Elev./Depth:** 28.5' @ 30.0'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	6.1	93.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	100.0		
#40	99.3		
#100	95.6		
#200	93.9		

* (no specification provided)

Soil Description

CLAY, trace sand, gray to brown.

Atterberg Limits

PL= 40.0 LL= 95.5 PI= 55.5

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

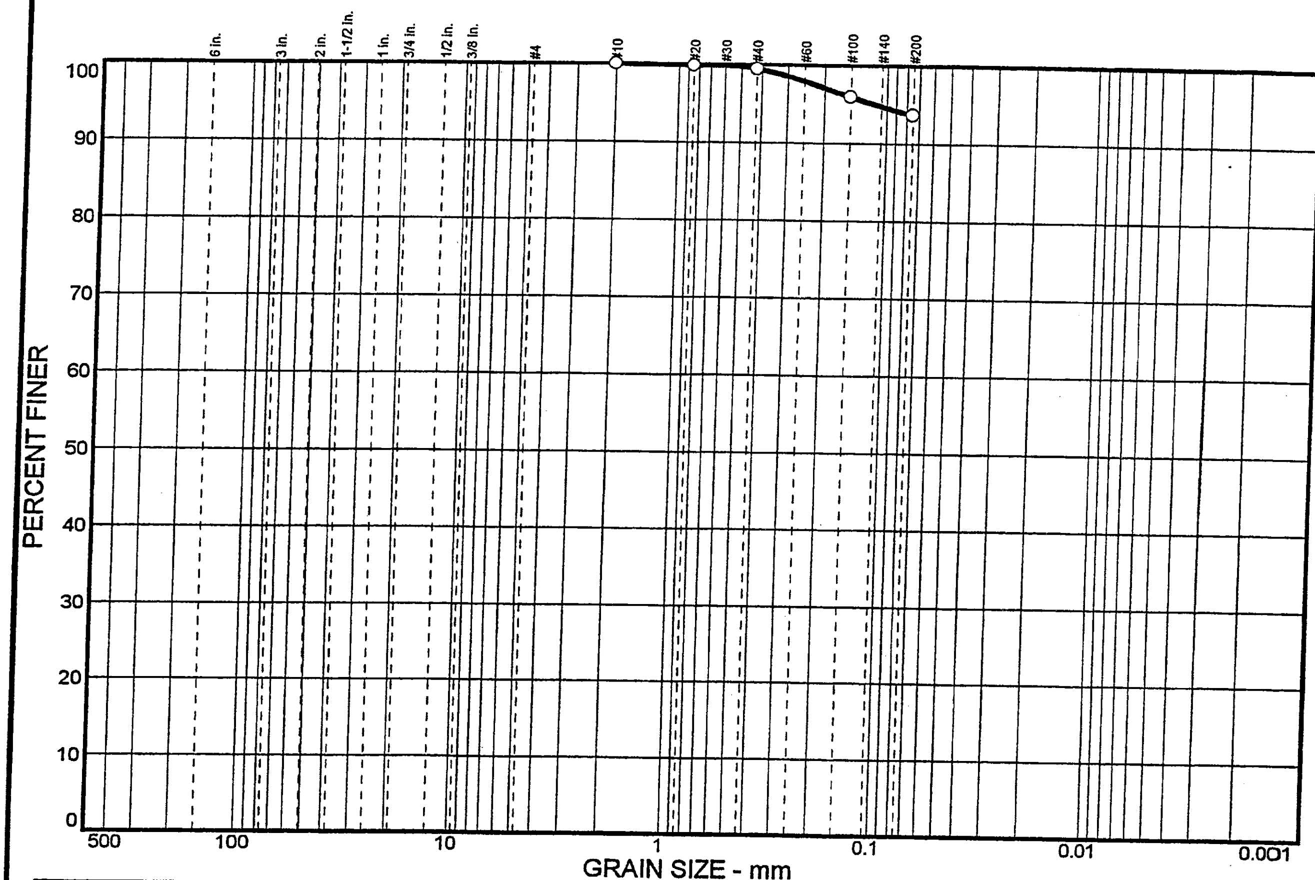
Remarks

Sample No.: 24-A **Source of Sample:** CB-MP98-14 **Date:** 6/25/98
Location: X=633281.747 Y=217755.456 **Elev./Depth:** 34.5' @ 36.0'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	6.3	93.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.9		
#40	99.5		
#100	96.0		
#200	93.7		

* (no specification provided)

Soil Description

CLAY, trace sand, brownish red to red.

Atterberg Limits

PL= 32.2 LL= 82.0 PI= 49.8

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

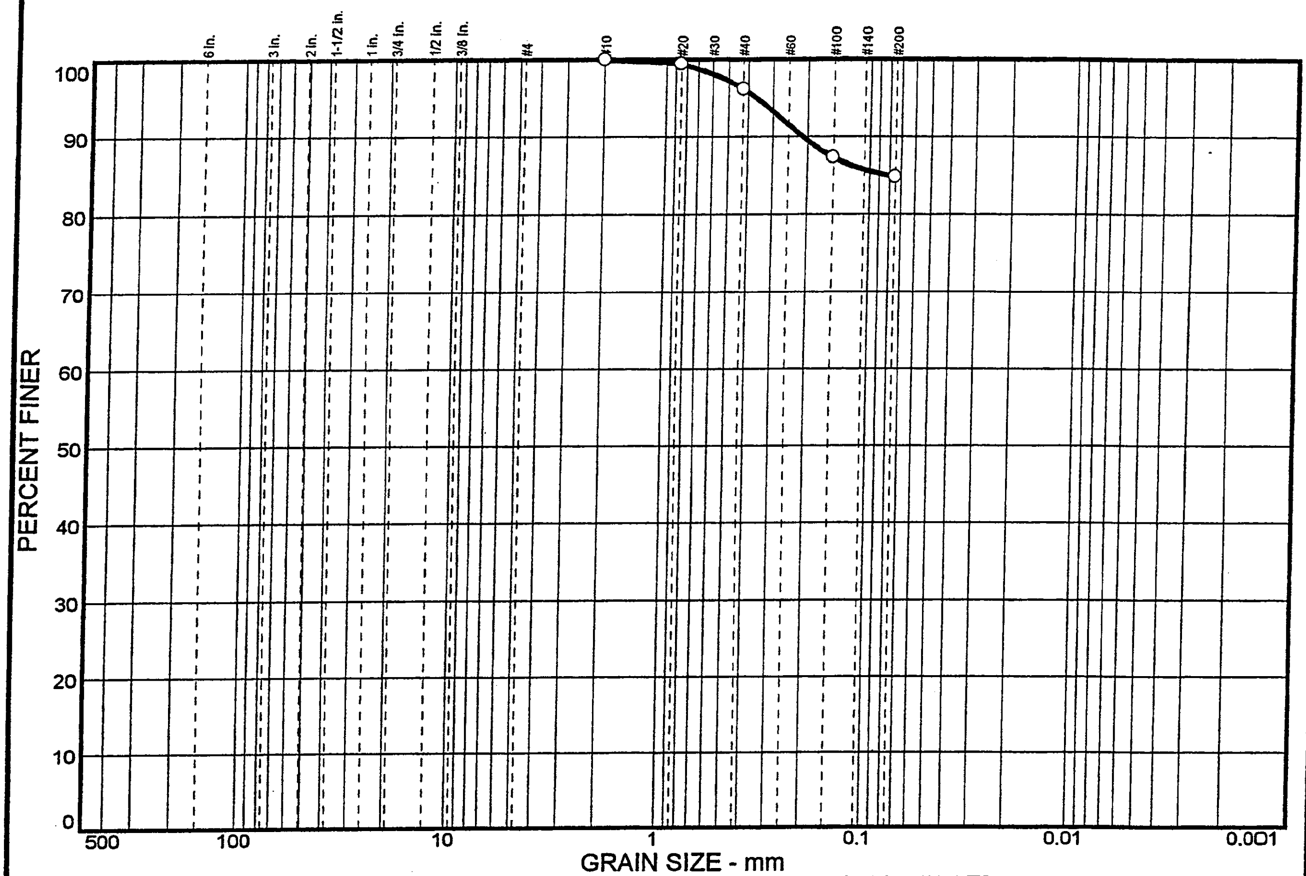
Remarks

Sample No.: 19-A **Source of Sample:** CB-MP98-15 **Date:** 6/15/98
Location: X=633483.951 Y=217331.032 **Elev./Depth:** 27.0' @ 28.5'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	15.2	84.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.5		
#40	96.2		
#100	87.3		
#200	84.8		

* (no specification provided)

Soil Description

CLAY, little sand, redish brown to gray.

Atterberg Limits

PL= 23.7 LL= 68.0 PI= 44.3

Coefficients

D_{85}= 0.0818 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

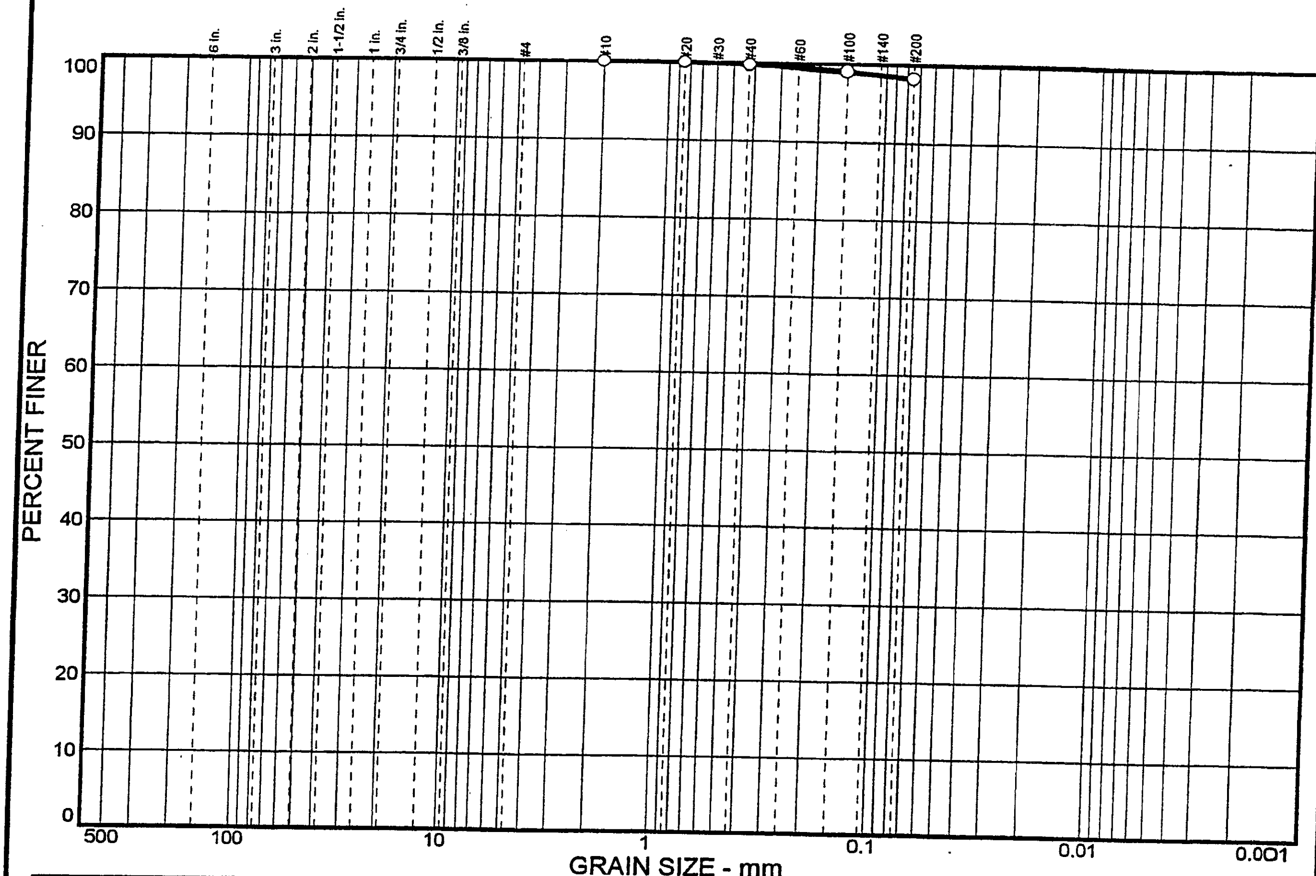
Remarks

Sample No.: 11-A **Source of Sample:** CB-MP98-17 **Date:** 6/22/98
Location: X=634040.780 Y=216863.230 **Elev./Depth:** 15.0' @ 16.5'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	1.7	98.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	100.0		
#40	99.8		
#100	99.1		
#200	98.3		

* (no specification provided)

Soil Description

CLAY, trace sand, brown to reddish brown.

Atterberg Limits

PL= 35.6 LL= 84.0 PI= 48.4

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

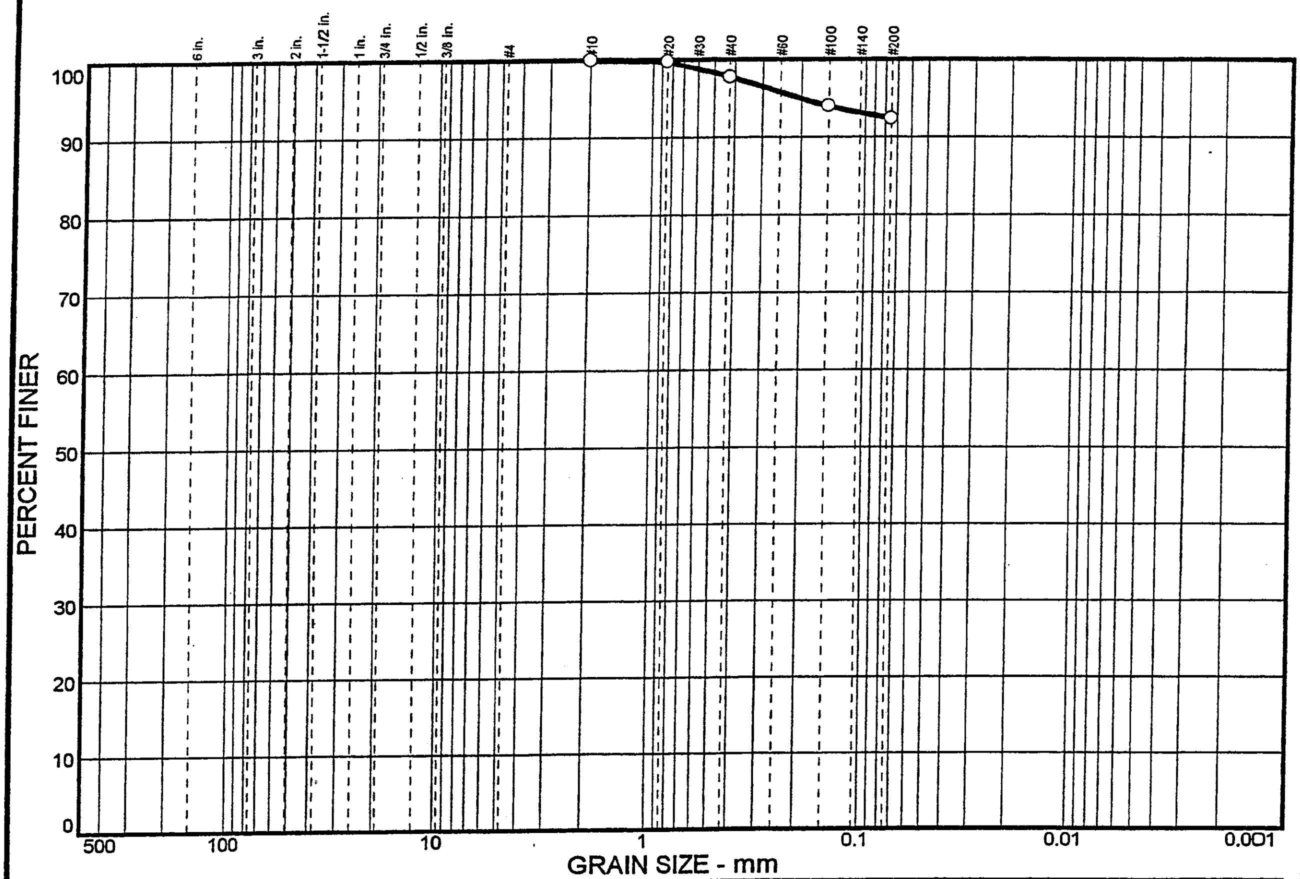
Remarks

Sample No.: 18-A **Source of Sample:** CB-MP98-17 **Date:** 6/22/98
Location: X=634040.780 Y=216863.230 **Elev./Depth:** 25.5' @ 26.0'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	7.6	92.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.8		
#40	97.8		
#100	94.0		
#200	92.4		

* (no specification provided)

Soil Description

CLAY, trace sand, reddish brownish gray.

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

Remarks

Sample No.: 30-A **Source of Sample:** CB-MP98-20 **Date:** 6/29/98
Location: X=635354.784 Y=217262.343 **Elev./Depth:** 43.6' @ 45.0'

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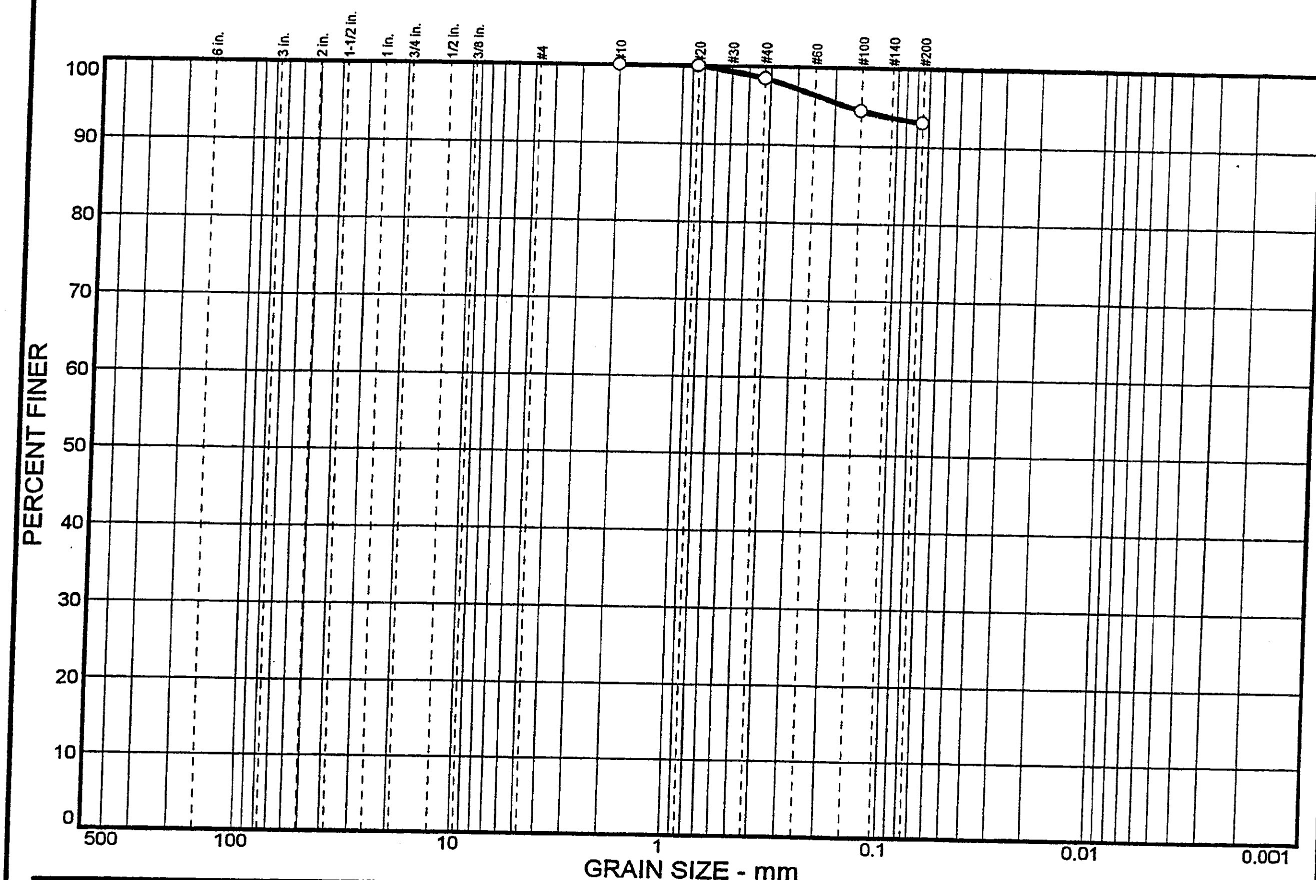
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	6.9	93.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	100.0		
#40	98.5		
#100	94.6		
#200	93.1		

* (no specification provided)

Soil Description

CLAY, trace sand, brown.

Atterberg Limits

PL= 30.5 LL= 89.0 PI= 58.5

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

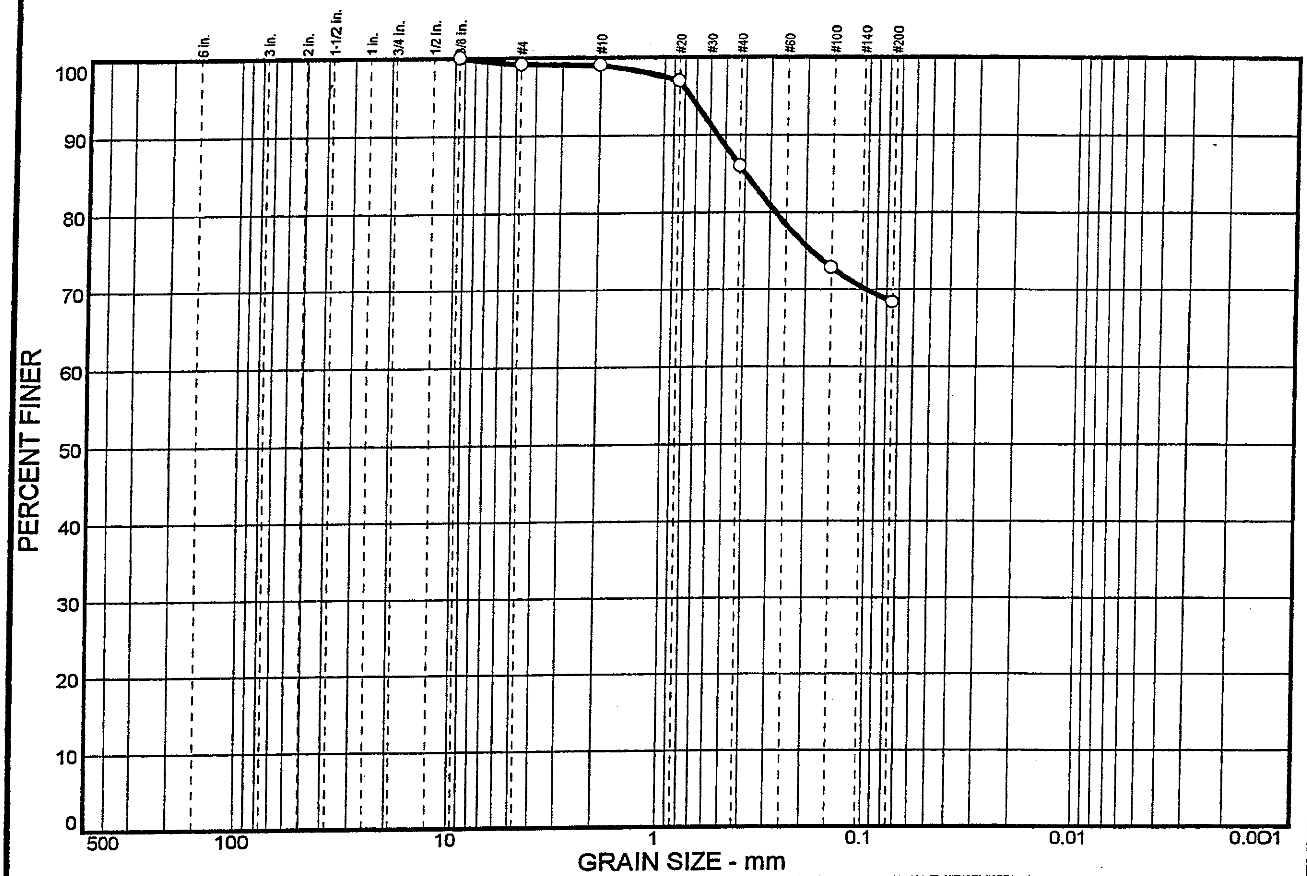
Remarks

Sample No.: 31-A **Source of Sample:** CB-MP98-20 **Date:** 6/29/98
Location: X=635354.784 Y=217262.343 **Elev./Depth:** 45.0' @ 46.5'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.8	30.9	68.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375 in.	100.0		
#4	99.2		
#10	99.0		
#20	97.0		
#40	86.0		
#100	72.9		
#200	68.3		

* (no specification provided)

Soil Description

CLAY, some sand trace gravel, ywllowish brown.

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.398 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

Sample No.: 30-A **Source of Sample:** CB-MP98-22 **Date:** 6/29/98
Location: X=636633.845 Y=217055.793 **Elev./Depth:** 43.5' @ 45.0'

GEO CIM, INC.

Client: Corps of Engineer
Project: Martin Pena Project
San Juan, P.R.
Project No: 2151-98 **R. Davila-GCI**